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Observations on Ignis Fatuus. By the Rev. John Mitchell.

Those luminous appearances, which are popularly called "Will-o'the-wisp" and "Jack-a-lantern," have been alike the object of vulgar superstition and philosophical curiosity; and notwithstanding all attempts to apprehend and subject them to examination, they are not much more the subjects of knowledge now, than they were centuries ago. They are still but an ignis fatuus to the philosopher, and a thing of mystery to the credulous.

I was myself, formerly, familiar with these appearances; they were of frequent occurrence near my father's residence, owing, probably, to the proximity of extensive wet grounds, over which they are usually seen. The house stood upon a ridge, which sloped down on three sides to the beautiful meadows which form the margin of the Connecticut, and of its tributary creeks, and which, owing to their own luxuriance and the deposits of the vernal freshets, are covered with rich and constantly decaying vegetable matter. From the circumstance, also, that we had no neighbours in the direction of these grounds, a light could not be seen over them without attracting our notice. I mention this by way of suggesting, that probably the ignis fatuus, in consequence of its not being always distinguished from the lights of surrounding houses, and therefore exciting no curiosity, is oftener seen than it is supposed to be.

These mysterious luminaries used often to be seen by the fishermen, who plied their nets by night as well as by day. They commonly reported that they saw them a little above the surface of the meadow, dancing up and down, or gliding quietly along in a horizontal line. Sometimes two, or even three, would be seen together,

skipping and dancing, or sailing away in concert, as if rejoicing in their mutual companionship. I might entertain you with abundance of fabulous accounts of them—the offspring of imaginations tinctured with superstition, and of minds credulous from a natural love of the marvellous. Fables, however, are of little value for the purposes of science: if the following account of some of the phenomena of the ignis fatuus, shall, with the observations of others, contribute towards a true theory of its nature, you will think them worthy of a place in your Journal.

A friend of mine, returning from abroad late in the evening, had to cross a strip of marsh. As he approached the causeway, he noticed a light towards the opposite end, which he supposed to be a lantern in the hand of some person whom he was about to meet. It proved, however, to be a solitary flame, a few inches above the marsh, at the distance of a few feet from the edge of the causeway. He stopped some time to look at it; and was strongly tempted, notwithstanding the miriness of the place, to get nearer to it, for the purpose of closer examination. It was evidently a vapour, [phosphuretted hydrogen?] issuing from the mud, and becoming ignited, or at least luminous, in contact with the air. It exhibited a flickering appearance, like that of a candle expiring in its socket; alternately burning with a large flame, and then sinking to a small taper; and, occasionally, for a moment, becoming quite extinct. It constantly appeared over the same spot.

With the phenomena exhibited in this instance, I have been accustomed to compare those exhibited in other instances, whether observed by myself or others; and, generally, making due allowance for the illusion of the senses and the credulity of the imagination in a dark and misty night, (for it is on such nights that they usually appear,) I have found these phenomena sufficient for the explanation of all the fantastic tricks which are reported of these phantoms.

They are supposed to be endowed with a locomotive power. They appear to recede from the spectator, or to advance towards him. But this may be explained without locomotion—by their variation in respect to quantity of flame. As the light dwindles away, it will seem to move from you, and with a velocity proportioned to the rapidity of its diminution. Again as it grows larger, it will appear to approach you. If it expires, by several flickerings or flashes, it will seem to skip from you, and when it re-appears, you will easily imagine that it has assumed a new position. This reasoning accounts for their apparent motion, either to or from the spectator; and I never could ascertain that they moved in any other direction, that is, in a line oblique, or perpendicular to that in which they first appeared. In one instance, indeed, I thought this was the fact, and what struck me as more singular, the light appeared to move, with great rapidity, directly against a very strong wind. But after looking some time, I reflected that I had not changed the direction of my eye at all, whereas, if the apparent motion had been real, I ought to have turned half round. The deception was occasioned by the

motion of the wind itself—as a stake standing in a rapid stream will appear to move against the current.

It is a common notion that the ignis fatuus cannot be approached, but will move off as rapidly as you advance. This characteristic is mentioned in the Edinburgh Encyclopœdia. It is doubtless a mistake. Persons attempting to approach them, have been deceived, perhaps, as to their distance, and finding them farther off than they imagined, have proceeded a little way, and given over, under the impression that pursuit was vain. An acquaintance of mine, a plain man, told me he actually stole up close to one, and caught it in his hat, as he thought;—"and what was it?" I asked. "It was'nt nothin."* On looking into his hat for the "shining jelly," it had wholly disappeared. His motions had dissipated the vapour, or, perhaps, his foot had closed the orifice from which it issued. To this instance another may be added. A young man and woman, walking home from an evening visit, approached a light which they took for a lantern carried by some neighbour, but which, on actually passing it, they found to be borne by no visible being; and taking themselves to flight, burst into the nearest house, with such precipitation as to overturn the furniture, and impart no small share of their fright to the family.

The circumstance that these lights usually appear over marshy grounds, explains another popular notion respecting them; namely, that they possess the power of beguiling persons into swamps and fens. To this superstition Parnell alludes, in his Fairy Tale, in which he makes Will-o'the-wisp one of his dancing fairies;

> "Then Will who bears the wispy fire,
> To trail the swains among the mire," &c.

In a misty night, they are easily mistaken for the light of a neighbouring house, and the deceived traveller, directing his course towards it, meets with fences, ditches, and other obstacles, and by perseverance, lands at length, quite bewildered, in the swamp itself. By this time, he perceives that the false lamp is only a mischievous jack-a-lantern. An adventure of this kind I remember to have occurred in my own neighbourhood. A man left his neighbour's house late in the evening, and at daylight had not reached his own, a quarter of a mile distant; at which his family being concerned, a number of persons went out to search for him. We found him near the swamp, with soiled clothes and a thoughtful countenance, reclining by a fence. The account he gave was, that he had been led into a swamp by a jack-a-lantern. His story was no doubt true, and yet had little of the marvellous in it. The night being dark, and the man's senses a little disordered withal, by a glass too much of his neighbour's cherry, on approaching his house, he saw a light, and not suspecting that it was not upon his own mantel, made towards it. A bush, or a bog, might have led to the same place, if he had happened to take it for his chimney top. [*Silliman's Journal.*

* In the colloquial double negative of the common people of New England. Ed.

On the penetration of Water into Stoppered and Corked Bottles, sunk to a great depth into the sea. *By* J. DE C. SOWERBY, Esq. F. L. S., &c.

[From the Philosophical Magazine, for August, 1828.]

MANY papers having at different times appeared upon the popular paradox, a bottle filling with water when sunk to a great depth in the sea, however well it may have been corked and sealed, without any satisfactory explanation having been given, and seeing the subject resumed by Dr. Green, in your Philosophical Magazine for this month, I am induced to send you my explanation of the phenomenon.

Dr. Green thinks that by proving (as others had done) that the water would not penetrate glass, he had reduced the question into very narrow limits; and that the water enters glass vessels through the "cork and all its coverings, in consequence of the vast pressure of superincumbent water, in the same manner as blocks of wood are penetrated by mercury in the pneumatic experiment of the mercurial shower."

It may be concluded from recorded experiments, that well fitted glass stoppers (by the by, every chemist knows such are rarely to be obtained as will confine the vapour of nitric acid) will exclude the water; corks, when properly protected, will also prevent the water from entering. When mercury is made to pass through a block of wood by pneumatic pressure, it finds its way by the longitudinal tubes; such tubes do not exist in cork. My explanation is this; cork is elastic, and by the pressure of the sea is readily condensed, and consequently much diminished in bulk, first that part out of the bottle where the sides are not protected by the neck, and then gradually the remaining length, until the cork, separated entirely from the glass, affords a free passage for the water, unless the sealing, or wrapper, be of such a tenacious and ductile nature as to adhere to the glass and the cork so as to fill up the space that would otherwise be left, and yet not yield completely to the pressure; if it be brittle, it either separates from the glass, or cracks, or both, allowing a free passage to the water. Even pitch, when cooled in the deep water, would be very brittle, and crack, or separate from the bottle readily, and it would resume its former ductility and appearance upon returning through the warm surface: this and similar considerations will show how a trifling difference in closing the bottles may produce considerable differences in the results of the experiments. I remain, yours truly.

J. DE C. SOWERBY.

Reply to MR. J. DE C. SOWERBY'S *remarks on* "*Experiments on the Pressure of the Sea at considerable Depths.*" *By* JACOB GREEN, M. D. Professor of Chemistry in Jefferson Medical College, Philadelphia.

[From the Philosophical Magazine.]

IN your valuable Magazine for July, 1828, there appeared some remarks made by me, "On the Pressure of the Sea at consider-

able depths;" and in the next number, J. de C. Sowerby, Esq. has favoured us with a kind of criticism on the communication. Now, although the subject is not a very important one, still no person feels satisfied with having his statements misrepresented, whether this be done through mere inadvertence, or in any other manner; I hope, therefore, you will allow me a word in reply.

The conclusion that I drew from my experiments, was, "that at the depth of 230 fathoms, the water enters glass vessels through the stoppers and coverings which surround them, and not through the pores of the glass:"—not that the fact, that water will not penetrate glass at all, as Mr. S. says, has been so often proved before, but merely that it will not at the depth of 230 fathoms. Now, if Mr. Sowerby had shown us that this fact had ever been proved before, his remarks would have been in point, and I should have thought my experiments of no value. The fact, however, never could have been proved without using a glass vessel *hermetically* sealed; and which, as far as my knowledge extends, never was done before. Mr. S. says, "Dr. Green thinks that by proving (*as others have done*) that the water would not penetrate glass, he has reduced the question to very narrow limits." Mr. S. should certainly have given us his authorities here; and until they are produced, I shall consider my experiment as the first to settle the fact.*

The misrepresentation to which I have alluded, is, that Mr. S. cites me as concluding that the water enters glass vessels through the "cork and all its coverings, in consequence of the vast pressure of superincumbent water, in the same manner as blocks of wood are penetrated by mercury in the pneumatic experiment of the mercurial shower." If any one will take the trouble to turn to the passage in your July number, p. 37, he will see that I have given this as the opinion of other experimentalists, whose names and works are referred to at the bottom of the page. A considerable part of Mr. S.'s short communication, is, to show that water will not pass through a *cork* in the same manner as mercury through a block of *wood*,—an opinion which I never maintained. I can, however, inform Mr. S., that mercury in the pneumatic experiment of the mercurial shower, will penetrate cork much in the same way as it does blocks of wood; and though not by *longitudinal tubes*, yet in a manner sufficiently analogous to justify the comparison made by the gentleman I have quoted.

Mr. S. concludes, "from recorded experiments, that well fitted glass stoppers will exclude the water." Now, for the same reason, I conclude that they will not: and as I have some authority for the fact, besides my own experiment, which, by the way, Mr. S. will not place among the *recorded*, he must produce further evidence.

* In the Rev. Mr. Campbell's account of his second Missionary Journey in South Africa, published about seven years ago, at the end of the second volume, Dr. Green will find the particulars of an experiment made by Mr. Campbell with two globular bottles hermetically sealed. They were sunk to the perpendicular depth of 200 fathoms, and on being raised, they were found *empty*; thus proving, that, at this depth at least, water will not penetrate glass.—ED.

For myself, I am by no means satisfied with Mr. S.'s explanation of the phenomenon alluded to. How that part of the cork which is protected by the neck of the bottle from the *lateral* pressure of the sea, should be diminished in its bulk, or diameter, by the perpendicular or superincumbent pressure, so as to be separated from the glass all round, is what I cannot understand. So far from getting the cork through the neck of the bottle, by Mr. S.'s mode of explanation, it seems to me that we shall only wedge it in the tighter.

There is one part of the explanation proposed by Mr. S., which struck me as a new fact. It is as follows: "even pitch, when cooled in the deep water, would be very brittle, and crack, or separate, from the bottle readily; and it would assume its former ductility and appearance upon returning through the warmer surface" (*warmer medium?*) Now, before this, I supposed that common pitch melted at about 150° Fahrenheit, and that the temperature of the ocean at a considerable depth, was much colder than at the surface. Even at the equator, the surface of the water is generally 80° Fahr., and it diminishes as the latitude increases. At a distance from land, where our experiments must be made, it also diminishes as the *depth* increases. In a *recorded* and authentic experiment, it was found that when the surface of the water was 40°, at the depth of fifty fathoms the thermometer stood at 25°.*

I could say more, but I fear I have already taken up too much of your space with this subject.

Yours, truly,

JACOB GREEN.

On the Cloth and Paper made from Amianthus, a Species of Asbestos.

[From the Virginia Literary Museum.]

AMIANTHUS, a variety of Asbestos, contains, per cent., about 59 parts of sand, (*silex*,) 25 of magnesia, and 10 of lime, besides traces of clay and iron oxide.—It is usually found in veins, and consists of fibres very flexible, and somewhat elastic. Friction readily separates them, and when dressed a little, they bear a considerable resemblance to fibres of silk or flax.

* We are at all times happy to insert the replies of writers whose papers may have been the subjects of animadversion in our pages; but we think that some passages of Dr. Green's reply to Mr. Sowerby, as above, require a few remarks from us. Mr. Campbell's anticipation of Dr. Green's experiment with a glass vessel hermetically sealed, has been noticed in the preceding page; and Dr. G.'s observations on the cooling of the pitch by the diminished temperature of the deep water, tend, as it appears to us, to confirm Mr. Sowerby's opinion. The appearance and ductility of pitch at temperatures of moderate warmth only, are alluded to by Mr. Sowerby, whose remark has no reference to its liquefaction; and the fact that the ocean at a considerable depth is much colder than at the surface, is the very ground of that gentleman's statement on this part of the subject. Some experiments with wine bottles secured with pitch, &c., made by Mr. Campbell at the same time he sunk the globular bottles already mentioned, also appear to confirm Mr. Sowerby's observations.—ED. PHIL. MAG.

This filamentous nature, and the power of enduring a red heat, without any very apparent loss of substance, have long rendered amianthus celebrated among minerals. All its names are in allusion to these properties, or their applications to useful purposes.

Asbestos, for example, the original term, comes from the adjective ασβεστος, *inextinguishable*, from a supposed practice among the Greeks, of using the mineral to form wicks for their perpetual or sepulchral lamps.

Amianthus, also, bears, in its etymology, an indirect allusion to the effects of fire. The word αμιαντος, which signifies "incapable of being soiled," was given in consequence of the facility with which articles, manufactured from this mineral, were cleansed by means of fire.

Other names were bestowed upon it, which may be briefly noticed —the Romans called it *Linum Vivum*, both from its resemblance to flax and its indestructibility. It was also named *Linum Indum*, *L. Montanum*, *L. incombustibile*, *Lana Montana*, *Salamandra lapidea*, &c. The last name seems to have arisen from a conjecture that the fable of the salamander originated from a practice among the ancients, of purifying by heat, the various fabrications of this mineral.

Asbestos and amianthus, are the terms which have passed into the principal European languages.

We have the most positive records, that this substance was in use among the Greeks and Romans, for the purpose of manufacturing articles in imitation of linen. The workmanship and quality, if we credit the testimony of Pliny and Plutarch, must have been of a very superior character.

The former writer ranks the amianth cloth, next in quality to the Byssus, or fine cotton, worn by wealthy ladies. Plutarch also states, that this mineral was wrought into head ornaments for females. It does not appear, however, that the art of weaving it was sufficiently general to render the cloth cheap. Indeed, every circumstance seems to show, that this fabric must have been an article of luxury among the ancients; and there certainly was an obvious, though, perhaps, excusable parade of its incombustible properties, upon all occasions. The practice in Pliny's time, and which he describes as an eye-witness, was, to toss the napkins of amianth into the fire, after a repast or banquet, in order that the grease and dirt might be burnt out. Each guest thus delighted in becoming his own washer. The same vain and clumsy display, we may observe, is recorded of the first dauphin, Charles V., during whose reign, amianthus manufactures seem to have been established at Venice, Louvain, and other parts of Europe. Pliny notices another very important use of mineral cloth, namely, as a shroud, or wrapper, for the bodies of kings, in order to preserve their ashes distinct from those of the funeral pile. That such a practice existed, we have positive proof, independently of the historian's testimony, by the discovery, in 1702, near the Porta Næva at Rome, of a funeral urn, ornamented with elegant *basso relievos*, and containing a scull with some calcined bones—a quantity of ashes was also found enclosed within a cloth

of amianthus, nine Roman palms long and seven wide. This relic was deposited in the Vatican library, by order of pope Clement XI. The very diminutive size agrees but badly with Pliny's account of its use, and will serve to caution us against confidence in his other exaggerated statements. It is said, that the disuse of burning the dead occasioned the decline of the manufacture of these cloths, until the art became entirely extinct in Europe. The correctness of this opinion will be noticed presently. Thread, nets, net-work, head ornaments, napkins, table and funeral cloths, seem to have constituted nearly all the articles manufactured of amianthus in former times. Bonnets, gloves, purses, girdles, ribands, and even paper, have been subsequently made from it. The process by which the mineral fibre was anciently woven, is not transmitted to us. In 1691, Ciampini of Rome, published the following plan in his work, "de incombustibili lino," and it may be considered nearly as precise as the nature of such manufacture will permit. Having steeped the amianthus in warm water, divide its fibres, by gently rubbing them together between the fingers, so as to loosen and separate all the extraneous matter; then pour on, repeatedly, very hot water, as long as it continues to be in the least discoloured. After this, nothing will be left but the long fibres, which are to be carefully dried in the sun. The bundles are then to be carded by very fine instruments, and the long filaments, thus obtained, steeped in oil to render them more flexible. A small quantity of cotton-wool, or flax, is next to be mixed (taking care that the mineral fibre is in every part, the principal material, and smoothly adjusted;) by means of a spinning wheel, the whole is to be drawn into a thread. The cloth being woven, in the usual manner, is placed upon a clear charcoal fire, and made red hot, so as to burn out the vegetable, or animal matter, &c. The remaining tissue will consist of pure white amianth. This kind of cloth has also been made, without the assistance of other substances, by rubbing and soaking the mineral fibres, until they become so delicate and soft as to admit of being spun at once into threads. This is the process recommended by Madam Perpeuti.

The very short fibres which separate, during the repeated washings, may be subsequently worked into paper. For this purpose, however, they require to be well beaten, until reduced to an impalpable powder, and, subsequently, to be worked up with a large quantity of size in water. These precautions are far more necessary for the amianth than for cotton or linen paper, in consequence of the much greater weight of the mineral paste. After the paper has been formed, the sizing is burnt out.

We will now briefly trace the decline of the mineral weaving, &c. It is apt to be the most glaring characteristic of the antiquarian virtuoso, to lament the loss of certain arts among the moderns, nor does *utility* always constitute an item of his regrets. The ancient process for weaving amianth cloth, appeared to be extolled, not from any accurate knowledge of the fact, but because an obscure hint or two about its superior quality, may be found among a few writers of antiquity. One of these authorities (Pliny,) it is true, compares it

with the byssine cloth, obtained from the neighbourhood of Elis, and which was very much esteemed; but, while he thus intimates its superiority, he elsewhere bears indirect testimony that the cloth was used merely as a rare and curious article. This writer furnishes three strong reasons why amianth cloth could not have been in common use among the Romans. The first is, the difficulty of procuring the mineral. It is described as occurring on the deserts and parched grounds of India, where rain never falls, and where serpents and other formidable reptiles abound. *Secondly*, it is stated that the amianthus, when obtained, was very scarce, and commanded a price equal to that of the most costly pearls. *Lastly*, it is expressly noticed that the workmanship was exceedingly difficult, on account of the shortness of the fibre. These statements are not only in opposition to the belief that the ancients used such articles generally, but the last one goes far to contradict the assertion of Pliny himself, respecting the quality. We have, however, a still stronger fact to show, that even in the rich and luxurious times of the Roman empire, the mineral cloth was not in much use for the purpose of collecting the ashes of the dead. Out of the immense number of ancient sepulchres opened in Italy, during modern times, not more than one such cloth has ever been discovered, and that (found at Rome, 1702,) is of very coarse texture, and too small to answer the purpose of a wrapper for the body. In several urns charcoal was found mixed with the ashes, a circumstance indicating no great care.

The truth is, that the cloth has always ranked as a curiosity, and, not unfrequently, has had bestowed upon it properties calculated for the credulous and ignorant. Pliny, who was ever too partial to hearsay records, has condescended to state, upon the authority of one Anaxilaus, that amianth cloth, merely wrapped round a tree, has the power of depriving the blow of a hatchet of all sound. The same relish for the marvellous, no doubt, induced Marco Polo to state, that the body of our Saviour was, in his time, preserved at Rome in a shroud of amianth, or incorruptible cloth. Athanasius Kircher, (a jesuit of the 17th century,) in his "*Mundus Subterraneus*," also extols the mineral with all the zeal of a connoisseur. He boasts of having, in his collection, paper, a screen, and a lady's veil of it, together with a lamp-wick, which had burnt for two years without consuming, and which, he wisely adds, will last for ever, if not stolen. Whether this wick is still in operation, we have not learnt, but may venture to conclude, notwithstanding the testimony of partial advocates, that the decline of the art afterwards among the moderns, is wholly owing to the insignificance of the articles manufactured.

Experiment has abundantly proved, that although the amianth fibres are alone able to resist a red heat without much change, they soon, (even in twenty-four hours) become incapable of transmitting a full supply of oil, owing to an imperfect cohesion effected by the flame. Hence it is impracticable to convert them into perpetual lamp-wicks. Neither is it true that a red heat has *no effect* upon them. Cloth, woven of amianth, actually does lose weight by burn-

ing, and, after repeating the operation several times, the fibres become so brittle as to render it difficult to prevent them from crumbling to pieces. In two experiments, made before the Royal Society of London, a cloth, one foot long by six inches wide, and weighing nearly 1½ ounce, was found to lose, by the application of a red heat, more than one-twelfth of its weight each time. It would be considered a very bad piece of common linen that could be worn out in twelve washings!—The only advantage which such cloth seems to possess over the ordinary kind, is, the facility of cleansing it by fire; but, really, soap is so cheap an article, that there could not be much gained in this respect, by a change of fabrics. The amianth paper has even less to recommend it. It would be curious, no doubt, to return an answer upon the same piece of paper as that which was received from the post office, merely by *burning out* the original; but it could not be agreeable to find our ink spreading at every letter, an inch wide, upon paper from which the fire had removed all sizing. So, also, it might appear highly important to possess an *incombustible* paper, upon which could be spread all important documents; but, (not to mention the thousand methods of getting rid of the troublesome records without burning them) we must bear in mind, that an *unalterable* ink is as important as the paper, and none of those proposed has been found to be sufficient. *Incombustibility* alone, must compensate for the article being heavy, coarse, weak, liable to blot, and not capable of taking the full impress of types. Books, it is true, *have* been printed upon this kind of paper, among which may be noticed the work preserved in the library of the Royal Institute of France; but, however highly authors may esteem their own productions, we feel fully persuaded that booksellers would not tolerate such nonsense from them now-a-days. To conclude, it may be observed, that, while it is not, by any means, our wish to interfere with the virtuoso's taste for neck-handkerchiefs and shirts of *stone cloth*, we must take the liberty of hinting, that, if the perfect art of weaving it *does not* now exist, there is not much lost. P.

On the Manufacture of Red and Flame Coloured Glass. By M. Engelhardt.

The ancients employed the oxide of copper for colouring glass red; but the colour which this oxide gives to the glass, is so intense, that glass of an ordinary thickness would be of a brownish-black colour, and but little diaphanous. It then becomes necessary, that in order to obtain a red colour, we must find out a process, by which this dark colour may be diffused, or thinly spread, over the glass without inconvenience. This may be effected by covering white glass with an exceedingly thin layer of the red glass; and by this contrivance we can unite the double advantage of having a fine colour, and a transparency also.

According to Kunckel, the oxide of gold is employed as the colouring principle in the colouring of red glass. And in fact the

oxide of gold does produce a fine red, with which glass may be coloured in fusion, without prejudice to its transparency; and consequently it may be advantageously employed in the making of vessels and other similar objects. But its employ must always be greatly circumscribed, on account of the high price of this colour, and other difficulties. Thus, for instance, we cannot always obtain from the oxide of gold, the fine purple or flame coloured glasses seen in the ancient windows of our churches; the glasses thus coloured have always a crimson, or rose tint, and may be distinguished at the first glance of the eye. The property which the oxide possesses of colouring glass red, may be readily proved with a mixture of the glass of borax, and the oxide of copper, and treating them with the reducing fire under the blow-pipe. For, in order that the copper shall produce a red colour, it is essentially necessary that it be treated in the reducing flame. And it is for this reason, that with the bellows we cannot apply it in the state of enamel, as with the other colours employed in tinging glass; because the red glass becomes changed to a bluish-green colour, by the fusion and the calcination of the copper in it.

Thus the ancients were obliged to use crude tartar, or lamp-black, or other de-oxidating bodies, when they would preserve their glass of a red colour. They also sometimes used the oxide of iron when they wished to obtain a red flame colour partaking of yellow; but the agent which produced the best result in this respect, was the oxide of tin. The effect of the oxide of tin was more certain and fixed than vegetable substances; but it also possessed the inconvenience of colouring the glass brown if the combustion was not perfect. During the whole time of working with the oxide of tin, they constantly kept the furnace at a uniform red heat; but this was not necessarily the case when they added the other de-oxidating substances. I have always found the oxide of tin in all the ancient glasses which I have analyzed; and not only this oxide, but generally, also, a much larger quantity of the oxide of copper.

As the colour obtained from the oxide of copper is too intense to be worked alone, the coloured glass being in some parts opaque, and in others appearing of a brown shade, and as it must be blown too thin for use, in order to obtain it of a transparent red colour, so they can only procure red and diaphanous glasses, by coating white glass with a very thin layer of the red glass. In this way they prepare a glass, which is termed *double glass;* and which has likewise the advantage of permitting us to remove the red coat, when we would either obtain white designs or drawings, or designs enamelled with other colours. We shall now state the process of the ancients, as we find used in all those glasses of the middle ages.

To manufacture this glass in layers, the workman employs two pots, or crucibles, the one containing the red glass, the other the white; he commences by plunging his iron *cane*, or blowing-tube, into the red glass, so as to bring out a lump of it, and then plunges it into the white glass. The cylinder blown out of this mixture, thus affords a glass of a fine red colour. In order that the red layer

should remain in perfect contact with the white glass, and should not detach itself in the cooling; it is necessary, that at the first forming, the union of the white glass with the red, be made completely perfect; it is also better that the mass of red glass should be heated hotter in the crucible than the white; and care must also be taken, that the component parts of the red glass should not be formed of any oxiginating substances. In order to commence working in the glass-house fire, I first put in the small crucible to contain the red glass, amongst the large pots. I then introduce into this first pot, in addition to the ordinary frit, or materials used to form glass, (provided that they contain no manganese,) two ounces of oxide of copper, and two ounces of oxide of tin, for every five pounds of the ordinary materials; but if it does not contain any such materials, I take for every two pounds of the sand contained in the frit, an ounce and a half of the oxide of copper, and an ounce of the oxide of tin. If I do not immediately add the oxide of copper, but introduce it afterwards, when the glass has become transparent, I then employ rather less of the oxide of copper.

To produce a scarlet layer, I take for every twenty-five pounds of the usual materials for making glass, half a pound of oxide of tin, and three-quarters of an ounce of the oxide of tin, made into an exceedingly fine powder; and these I add at the commencement of the operation.

When the mass has become transparent, I then put in three-quarters of an ounce of the oxide of copper, and mix the whole with great care. In general, I also take every possible pains to prevent the formation of any bubbles, or lumps in the glass, which are but too apt to take place; I likewise take care that both the masses of the white, and of the red glass, be brought to the same degree of fusion whilst they are being worked.

The perfectly forming of a fine glass, depends very much upon the skill of the workman, and he ought to make himself master of the details I have above given; observing also, that the outer layer of glass should be thinner at the mouth of the tube, than at the opposite side of the cylinder; or else the glass would necessarily be deeper coloured at that end than the other, and then the centre would not present an even tint; and indeed, if one of the ends should become too thin, the colour would entirely disappear, and be lost in the white glass. I possess many glasses, however, in which the transition from the dark to the light tints, is employed in producing certain effects with great advantage.

For the rest, the workman may soon acquire, by a little practice, the necessary dexterity to enable him to make uniform glasses, and of sufficiently large dimensions; and I hope to obtain this result in all our glass-houses, having made arrangements to that effect.

A mass, or frit, containing lead, appears to preserve the red colour better than any other; nevertheless, my experience in this respect, is not sufficient to enable me to pronounce decisively thereon. When the red colour of the glass in the furnace disappears at any time, owing to the oxidation of the copper, and the glass takes a

bottle-green colour, by adding a de-oxidating body to it, such as charcoal in powder, crude tartar, lamp-black, or other analogous substances, we can again produce the red colour. The crude tartar, or the charcoal, are preferable for this purpose, as they can be more readily obtained in a state of purity than the lamp-black. After adding these de-oxidating matters, we should not use the upper layer of glass in the crucible, which is too deeply coloured, and too impure; but the lower parts soon become very fine, and of a clear tinge. Nevertheless, as that red is always the most beautiful in which there has been no occasion to employ these matters, so we should endeavour to avoid the necessity of adding them as much as possible, and strive to keep the mass of red glass continually transparent in the furnace.

Remarks by the Editor of the Technological Repository.—We believe that this process of forming red glass by what is termed *flashing* white glass, has long been used in this country; and particularly by the late Mr. Honeybourne, of Brierly Hill, near Stourbridge, who was celebrated for his skill in making coloured glass. And we continually see the small red glass lamps, used in public illuminations, thus formed. The process may not, however, have been practised in modern times in Prussia; and this communication will, therefore, no doubt, prove highly useful there, as well as in other countries also. [*Tech. Rep.*

On the Materials which the Romans employed in their Buildings.

By Mr. C. T. Ramage, A. M. *of Naples.*

The materials which were used in the erection of the various edifices, which add so much interest to the ancient city of Rome, may be ranged under two great classes. The first consists of the common materials for building, which were found in the immediate neighbourhood of the city, such as limestone, pozzolana, clay, and silex; the second, of those which were brought from a distance, white and coloured marbles, granites, and porphyries.

Their mortar was made, as it is at present, either from common limestone, or from a stone which Vitruvius calls silex, and which may, perhaps, correspond with our compact calcareous limestone. That which was obtained from the last, was employed in the construction of walls, while the other was used as plaster. This mortar was mixed either with *Arena fossica*, sand dug from pits, or *Arena fluviatica* and *marina*, from rivers and the sea. Of the first they had several sorts, black, white, and red, together with that to which we give the general name of *pozzolana*. The vicinity of Rome abounds with this last sort, and the inhabitants still use it for the same purpose. The place from which the sand was dug, was called *Arenarium*, and these excavations have, no doubt, given rise to the catacombs in Rome. The colour of this *pozzolana* is by no means uniform, for it is sometimes found red, sometimes purple, and some-

times the colour of tobacco. Its name is derived from *Pulvis puteolanus*, because it was originally found in great quantities in the neighbourhood of Pozzuoli, near Naples. It was particularly used for buildings under water, because it resisted the influence of that element, and acquired such a consistency as to form a solid mass of stone and brick. A proof of this is found in the ruins of the harbour of Antium, and of the mole of Pozzuoli, which is called the bridge of Caligula, though it must date its origin long before the reign of that emperor. It is curious to observe, that on the shore of Baiæ, where Horace accuses the Romans of attempting to deprive Neptune of part of his territory, the foundations of the houses in the sea still remain, while those on the shore have entirely disappeared, and left scarce a vestige behind them. On examining these foundations, it is found that they consist of this sort of cement, bricks, and sometimes pieces of tuffa. The sand from the sea and river was never employed when the other sort could be found, and the same observation may be made regarding gravel (glarea.) The cement, according to Vitruvius, was composed of three parts of pit sand and one of limestone, or, rather, of two parts of river, or sea sand, and one of lime. They generally added a third part of pounded shell, to correct the defects of the sand, and to render the cement more firm and tenacious.

Clay was employed in the formation of their bricks, and must have been in great request in Rome, as their buildings are chiefly composed of this material. We are told by Vitruvius, that, in his time, the bricks were dried by the rays of the sun, and he enters into a minute description of the method which they employed; in the ruins, however, existing at Rome, we observe only bricks baked by artificial fire. On an attentive examination of those found in Rome and Pompeii, we discover that the clay which they used was generally of two sorts, yellow and red, and that they mixed with it tuffa dust to render it more compact. Their size differs according to the use which was made of them, and the time they were formed. The bricks employed in courts are generally triangular; those which we call tiles, and which served to bind together the roof to the entire mass of the wall, are a foot and a half square; and those which were used for arches, are quadrilateral, and are a foot and a half long, and half a foot broad. All the ancient bricks are much finer in the grain, and are easily distinguished from those of the present day.

The stones which were employed in the buildings of ancient Rome, are the following: tuffa, which Vitruvius calls lapides rubri; peperino, or lapis albanus; travertino, or lapis tiburtinus; silex, and pumice-stone. The first four are found in the foundations and outer facings of the buildings, as well as in the internal construction of the walls and vaults; the silex was only employed in the pavement of the streets, and the interior masses of the wall; the pumice-stone was particularly used in vaults from its lightness. Tuffa is found in every part of the country round Rome; and the ancient quarries, alluded to by Strabo, may be seen near the Anio, at Cerveretta, five miles beyond the Porta Maggiore, to the left of the Via

Collatina. It is a volcanic production, of a colour more or less red, and of no great solidity, as it is easily decomposed by exposure to the atmosphere. The foundations of the buildings on the Palatine Hill, are of this stone, and the temple of Fortuna Virilis, and the aqueduct of Claudius, are also built of it. In this case, they either rough-cast the outer part of the wall, or cut it in sufficiently large pieces to resist the action of the air; the first method is observed in the above mentioned temple, and the other is found in the aqueduct of Claudius. Tuffa was employed also in Rome and its neighbourhood, for that sort of building, which, from its form, was called reticulated. This commenced on the decline of the republic, and ceased about the time of Caracalla. The vicinity of Naples abounds also with this stone, and, indeed, the city is almost entirely built of it. The grotto of Posillipo passes through a mountain of this sort, and the perforations in the neighbourhood of Cumæ, Baiæ, &c., which are supposed to have been the abodes of the Cummelii mentioned by Homer, are dug in the same volcanic matter.

Lapis albanus, Peperino, also a volcanic production, derived its name from Mount Albanus, and its quarries are seen at present in the neighbourhood of Marino; its greenish grayish colour, and the resemblance it bears to pounded pepper, has given rise to the vulgar name of Peperino. This stone, as well as that called *Lapis Gabinus*, resists the action of fire, and, on that account, Nero, according to Tacitus, issued a decree, after the burning of Rome, that all the houses should be built of one or other of these stones. The peperino is more solid than tuffa, and is less influenced by atmospheric changes, though it also suffers. The walls of Servius, at Rome, were built of it, as may be still observed under the temple of Victory, on the declivity of the Quirinal, where there are still some remains. It has also been employed in the erection of the enclosure of the forum of Nerva, the temple of Antoninus, and Faustina, &c. The *Lapis Gabinus* very much resembles peperino, and is found at Gabii, about twelve miles from Rome. Its colour is the same; but it is much harder and more porous; the ancients employed it more particularly for millstones.

Travertino, a name corrupted from Lapis Tiburtinus, was brought from the neighbourhood of *Tibur*, Tivoli; and even now you see the ancient excavations between the *Aquæ Albulæ* and *Pons Lucanus*, to the right of the road. It is a calcareous concretion, formed by sulphureous waters, and those of the Anio; it is extremely porous, resists the action of the atmosphere, and hardens in proportion as it is exposed; fire, however, decomposes and calcines it. The amphitheatre of Flavius, the sepulchre of Metella, and many other monuments on the Appian Way, are of this stone. Its colour is originally white, but, from long exposure, it acquires a yellowish hue, which adds much to the beauty of the buildings. The Romans cut it in large quadrilateral masses, and employed it without cement for their edifices. The temples and walls of Pæstum are of the same material, and the quarries where the cyclopic masses were excavated, are seen without the walls of the city. Some of the stones are twenty-four

feet in length. There is a bridge at Benavento, which is observed to be of the same structure and same material. *Silex* is a different stone from the one which is known to mineralogists under that name; it is a basaltic lava, of an iron colour, which, from its peculiar hardness, was employed in walls and the pavement of streets. The quarries are found on the Appian Way, beyond the sepulchre of Cecilia Metella, and in many other places in the vicinity of Rome. Pumice-stone,* from its extreme lightness, was reserved for the erection of vaults; and you find it employed in those of the Coloseum, and the magnificent cupola of the Pantheon. It was brought from the neighbourhood of Vesuvius.

These are all the common materials which the Romans employed; and before we proceed to notice those ornametal stones, which added so much beauty to their edifices, we shall attempt to mark the different epochs in Roman history, when these materials were used.

The most ancient Roman buildings are constructed of the lapis albanus, because Alba was the first important conquest which the Romans made; and it is natural to suppose that they would prefer the stone which could be most easily procured. This continued to be used, not only during the regal government, but almost to the fall of the republic. The Carcer Mamertinum, constructed by Ancus Marcius; Cloaca Maxima, the work of the Tarquins, parts of the wall of Servius, under the Quirinal; the sepulchre of the Scipios, and many other ancient monuments, are built of this stone. When Tibur was subdued, A. M. 417, they began to introduce Travertino, which was ever afterwards promiscuously used with the lapis albanus. As it is harder and more compact than peperino, it was particularly used for ornaments, arches, and architraves. Thus, the doric capitals and architrave of the tabularium, the insulated columns of the temple of Fortuna Virilis, and the arch of Dolabella on the Mons Cœlius, are composed of this stone. As far as we can perceive from the remains of antiquity, square masses of stone were used during the kings and the republic. But on its decline, they introduced that sort of construction which Vitruvius calls *Opus Incertum*, and which must not be confounded with that formed of large polygons, which we see at Cora, Præneste, and other ancient cities of Latium. Vitruvius, indeed, tells us, and we can perceive it from the ruins, that this *opus incertum* consisted of small stones mixed with mortar. There is an example of it in Rome, in the temple of Romulus, under the Palatine; at Tivoli, in the temple of Vesta; at Præneste, in the temple of Fortune, and in many other ruins scattered through the country. On the contrary, the walls of the above mentioned places are built of massive polygons of three, four, and five feet in length, and without mortar. The *opus incertum* is only an outward facing of the wall, and is supported behind by a mass of every sort of material.

The *opus incertum* was soon succeeded by the *opus reticulatum*,

* The pumice mentioned above, is, we presume, vesicular lava, not the pumice of geologists.—Ed.

which is mentioned by Vitruvius, as the fashionable architecture of his age, and which continued to be, more or less, used down to the reign of Caracalla. This reticulated construction derived its name from its resemblance to net-work, and was formed of stones found in the neighbourhood, which were cut into the form of coves. At Rome, the stone is tuffa; at Præneste, calcareous limestone; at Tivoli, travertino; and at Tusculum, a kind of peperino, which the Italians called *Piatra Tusculana.* As this particular sort of construction could not be used in the angles of houses, they seem generally to have introduced bricks, and sometimes stones of a rectangular shape. There are several beautiful specimens of this reticulated work at Rome; the gardens of Sallust, under the Quirinal, and the palace of Mæcenas, may be mentioned as worthy of inspection. In both these, you see this net-work promiscuously used with bricks, regarding which we shall now make a few observations.

The *Opus lateritium*, or brick-work, began to come into general use in the time of Augustus, and maintained its ground to the fall of the empire; it was nearly equal in strength to the massive stone-work which was originally employed. There were many changes during this long period, in regard to the form of the bricks, and the quantity of cement. In the reign of Augustus, they were generally made of a red earth, of a triangular form, and about an inch in thickness, as may be seen at the gardens of Sallust, at the palace of Mæcenas, under the Esquiline, and at the palace of Augustus on the Palatine. Under Tiberius, the earth was of a deeper red, or yellowish, as is proved by the prætorian camp without the Porta Pia; and in the time of Nero, they mixed the yellow and red bricks in their buildings, as the aqueduct near the Porta Maggiore shows. They are much smaller than those of Augustus and Tiberius, and very little cement seems to have been placed between them. There are some other remains, in different parts of Rome, that seem to be of the same age and construction. Of the brick constructions of the time of Vespasian and his sons, we have some magnificent specimens in the amphitheatre of Flavius, the baths of Titus on the Esquiline, and the villa of Domitian. The two former approach nearer the construction of Augustus, and the latter resembles the brick-work of the palace of Mæcenas. The edifices built in the reigns of Trajan, Adrian, and the Antonines, exhibit the same construction, and though the baths of Caracalla are evidently deficient in good taste and beauty of design, yet the brick-work is nearly equal to that of the best times. After this there was a rapid decline in every thing connected with architecture, and even the brick-work did not maintain its original solidity. They no longer attempted to make them equal in size, and they introduced large portions of cement, which tended much to weaken the strength of the walls. From Caracalla to Diocletian, there are few remains, and even of these we are unable to fix the exact period when they were erected.

It is curious to observe, that they now began to be economical in the use of bricks, and that they introduced a mixture of tuffa, as is evident from the restoration of the tomb of the Scipios, the circus of

Caracalla, and the ruins adjacent to the circus. The numerous churches and basilicos, which were erected by the christians in the fourth, fifth, and sixth centuries, such as St. Croce a Gerusalemme, St. Geovanni e Paolo, St. Paolo, St. Pietro in Vincoli, &c., and the walls which surround Rome on the left bank of the Tiber, and which are of the age of Honorius, exhibit the same poverty of materials; they have bricks of all sizes, with a great quantity of cement, which is of inferior quality to that used in earlier times. On the fall of the Roman empire, they even neglected the selection of proper materials to form their bricks, and even employed those which they took from more ancient buildings. At last they invented a method of cutting the softer stones, tuffa and peperinos, into small rectangular masses, and discarded entirely the use of bricks. The Italians call this *Opera Saracinesca*, because it was introduced when the Saracens occupied Italy. The walls of the Vatican, built by Leo IV. in the ninth century, are the first specimens which we have of it in Rome. This sort of construction continued to be used during the barbarous ages till the fourteenth century; the castle of *Capo de Bove*, near the sepulchre of Metella, built by pope Boniface VIII., is a beautiful specimen of it. They sometimes cut marble in this rectangular shape, as may be seen in *Sorre de' Conti*, a work of Innocent III. of the thirteenth century.

To conclude this part of our subject, we may remark, that the Romans, during the kings, and the time of the republic, employed in the public edifices, square masses of stone; on the decline of the republic, they introduced *opus incertum;* under Augustus, *opus reticulatum* and *lateritium*, were promiscuously used; the *opus reticulatum* ceased under the Antonines, but the brick-work continued to the seventh century, and was succeeded by the *opera Saracinesca.*

We must reserve the observations we have to make on ancient marbles, granites, porphyries, and alabaster, till another opportunity.

[*Edinburgh Phil. Journ.*

Experiments with Bottles sunk into the Sea, made during a voyage from New South Wales. By MR. JAMES DUNLOP, *in a letter to Professor Jameson.*

SIR,—Having on my voyage (*per* ship Portland) from New South Wales, made the following experiments with bottles, &c. sunk into the sea, if you find a description of them to be of service, they are at your disposal.

Experiment 1.—April 9, in lat. 24° south, and long. 43° 10′ west, the ship becalmed off Rio de Janeiro, the boat was lowered down, and rowed a short distance from the ship; the deep-sea lead was let down 80 fathoms, with the following experiments attached to it, consisting of a common porter bottle well corked and pitched over, and secured by a covering of new canvass, which was also covered with a thick coat of pitch; also a tin canister with holes pierced in its bottom, and open at the top, in which were placed four small ther-

mometer tubes, filled with mercury, all of which would burst with a less temperature than 100° of Fahrenheit; also five small glass globes hermetically sealed by the blow-pipe, two of which were vacuum, (or as nearly so as I could make them,) other two were suffered to cool, previous to their being sealed, and the fifth contained a small globule of mercury, to enable me to detect any damp, as an experiment on the porosity of glass; three glass phials, well corked, and firmly secured by leather coverings, tied round the necks, and further secured by a coating of sealing wax, were also put into the canister. After letting them remain ten minutes at the depth of 80 fathoms, the line was hauled in, and the experiments examined. The porter bottle was nearly filled with water, and the cork floating inside; the covering of canvass and pitch was pressed concave into the mouth of the bottle, but the pitch was not cracked or broken. The four thermometers, and also the small glass globes, came up unbroken. I examined the one which contained the small globule of mercury, and it gave not the slightest indications of damp having penetrated through the glass. The three phials came up full of water: of one of them the cork was forced in, and swimming in the water; in another, the cork was forced about half an inch into the neck; and the cork of the third was not apparently affected or displaced in the least degree, although the phial was full of water, and also several pieces of the sealing wax lying in the bottom, which by no means could have got into the bottle, but by the cork being driven in. The wax on the top of each was broken or cracked in regular concentric rings from the centre, and the coverings of leather burst, as well that in which the cork was not displaced, as in the others. Indeed, the hole in the leather which covers the phial with the remaining cork, is larger than in the others, in which the cork is driven in; which, in all probability, may be accounted for, by considering this cork to have been tighter fitted into the phial, and requiring a greater force to displace it: there would be a greater rush of the water into the phial, and the cork forced again into its neck. I think it more than probable this has been the case, otherwise the bits of sealing wax could not have got into the phial had the cork retained its situation; neither could we account for the bursting of the leather and wax which fastened down the cork.

In preparing for the second set of experiments, I attempted to guard against the possibility of the corks being forced in, or the pressure of the superincumbent column at all affecting the corks. I prepared two (four or five ounce) phials: the corks were dipped in strong gum dissolved in ether, and thrust into the mouth of the phials; they were allowed to remain in this state for several days to dry. The corks were then cut close to the mouth, and covered with several thick coats of varnish, and afterwards covered with leather firmly tied round the neck, which was also covered or soaked in varnish, and suffered to dry; and for farther security, the heads and necks of the phials were immersed in brass caps, filled with melted sealing wax, to prevent the possibility of pressure upon the corks. I also prepared a small phial, by simply thrusting in the cork

as tight as possible, and cutting it close to the mouth, and afterwards covering the mouth and neck of the phial one-fourth of an inch thick with black sealing wax. On the 15th May, in lat. 5° north, and long. 26° west (the ship becalmed,) these three phials were wrapped in old canvass, and, together with the thermometers and glass globes used in the former experiments, were all put into a tin case, open at the top, and fastened to the line just above the lead: a porter bottle, fitted up as formerly, was also attached to the line. The boat was rowed a short distance from the ship, and the lead let down 180 fathoms, and allowed to remain about eight or ten minutes at that depth before we commenced hauling in the line. On examining the experiments, the two (five ounce) phials, which were secured by the brass caps, were broken or crushed to powder, with the exception of the thick part of the bottom, and the neck, which was protected by the brass caps. The other small phial, which was much stronger in the glass, and only secured by the cork, covered one-fourth of an inch thick with sealing wax, was not broken or injured in the least, though a very minute quantity of water had found its way into the phial, probably through the wax and cork, and I have no doubt, had the phial been allowed to remain sufficient time at that depth, that it would have filled with water, probably without breaking the wax, or forcing in the cork. Neither the thermometers nor the small glass globes were broken, nor could I perceive the slightest appearance of damp in the small globe which contained the globule of mercury, to indicate porosity in the glass. The porter bottle came up full of water as formerly.

The porter bottle in this, and also in the other experiment, was prepared by captain Mood, commander of the Portland, who assisted and gave every facility for making experiments, when the weather and circumstances would permit.

My object with the thermometer, was to ascertain whether an increase of temperature took place at a considerable depth in the ocean; and not being provided with a self-registering thermometer, the only resource I had was to make several about three inches long, and by immersing the bulbs in water heated to a known temperature, the superfluous mercury was forced out, and the moment it began to subside, the tube was sealed by the blow-pipe. The one which indicated the lowest temperature, required about 73° or 74° of Fahrenheit to raise the mercury to the top of the stem; but experiment proved the unsatisfactory results I might have expected, as it required a temperature above 80° to burst the slender bulb. The experiments of captain Sabine and others, prove the temperature of the ocean to decrease at considerable depths below the surface.

I think it can hardly fail to convince any one who makes the experiment of sinking bottles in the sea, and assists personally at the hauling in of the line, that the great force necessary to haul it in must be occasioned by the pressure of the superincumbent column of water. And I have no doubt that the same experiment may be performed, and powerful effects produced, on a bottle well corked and secured, being placed in a cast-iron cylinder filled with water,

and the *force applied by a hydrostatic press*, on the top of a solid piston (which must be well fitted into a smaller cylinder fixed on the top of the larger one,) the piston pressing upon the surface of the water in the small cylinder. And many interesting experiments might be performed in the lecture room, by substituting a very strong cylinder of glass, having its ends ground parallel, and fitted into brass caps accurately ground to fit the outside of the ends of the cylinders, and the bottom of the caps lined with leather, to prevent the pressure of the screws, necessary to connect the caps and keep them water-tight, from chipping the glass. To one of the brass caps must be fixed a well bored cylinder, for the solid piston to slide in, &c. Sea water might be used in the cylinder, with a thermometer to show what capacity water may have to retain its caloric when under a high pressure. Such experiments would be interesting to compare with experiments which have been made on the temperature of the sea at great depths; and also the specific gravity of the water in the cylinder ascertained before and after the experiment, which would probably throw light on the subject of increased specific gravity of water drawn from great depths, and also whether the effects of pressure on water are permanent, and owing to the imperfect elasticity of water. I am, &c. JAMES DUNLOP.

August 25th, 1827. [*Ib.*

Observations on the Cow-tree of the Caraccas. *By* MR. DAVID LOCKHART, Curator of the Botanical Garden in Trinidad.

I HAVE just returned from an excursion to Caraccas, where I collected the juice of the cow-tree, (Palo de Vaca,) and I have now the pleasure of sending you a phial of the milk, together with a few leaves, and a portion of the root of the tree. The *Pala de Vaca*, is a tree of large dimensions. The one that I procured the juice from, had a trunk 7 feet in diameter, and it was 100 feet from the root to the first branch. The milk was obtained by making a spiral incision into the bark. Carauo, the place where I met with the tree, is about fifty miles east of La Guayra, and at an elevation of from 1000 to 1200 feet above the level of the sea. It is likewise found between Cape Codera and Barcelona. The milk is used by the inhabitants wherever it is known. I drank a pint of it, without experiencing the least inconvenience. In taste and consistence, it much resembles sweet cream, and possesses an agreeable smell. I was so fortunate as to procure some young trees and roots of the *Palo de Vaca*, which I will endeavour to increase, and, if I prove successful, you may expect to have a plant. I am sorry that I was not able to collect any specimens worth sending during my visit to Caraccas, my stay being limited to eight days, six of which were spent in procuring the cow-tree. I, however, picked up a few seeds, which are sown in a mixed state at St. Ann's, and which are likely to afford something interesting. I am glad to hear that botany goes on prosperously in Europe. I am sorry to say, that, during nine years' residence in this

part of the world, I have found very few persons who take an interest in the advancement of science, the principal aim of the people here being to make money in every way they can. For the last eighteen months, from close attendance to the garden, I have had but little time to devote to collecting.

Note by Mr. Don.—I had an opportunity of examining attentively the leaves of the *Palo de Vaca*, and found them to approach very close to those of several South American species of *Ficus*. The disposition of the nerves and veins was precisely similar, which, together with the insertion and consistence of the leaves themselves, appear to justify the propriety of the place assigned to the *Palo de Vaca*, by M. Kunth, who has arranged it in the family of *Urticeæ*, under the name of *Galactodendron utile;* but neither he nor myself have seen either the flower or fruit; so that as a genus, it rests on very insufficient grounds. The tree, however, is evidently related either to *Ficus* or *Brosimum*. The juice contained in the phial sent to Mr. Lambert, had the appearance of sour cream, and, notwithstanding that it had suffered materially from the long voyage, the taste was by no means unpalatable. [*Ib.*

Notice of a patent for Iron Sheathing for Ships, obtained by G. S. Pattison, Esq. *of London. Dated January*, 1829.

[From the London Register of Arts.]

To devise some means of preventing the rapid corrosion and annihilation of the copper sheathing of ships, has, of late years, attracted the attention of our most enlightened chemists. Sir H. Davy having discovered that the action of sea water upon copper was of a galvanic nature, placed small pieces of tin and zinc, in contact with its surface, which had the effect of preventing the oxidation of the copper, owing to its being thereby rendered negatively electrical. Ships were sheathed on this principle, and sent to sea, but they proved to be such bad sailers, that the scheme was soon abandoned. It is true, that the copper was protected by the zinc, from the corroding effects of the sea water, but in thus getting rid of one enemy, it introduced a greater, in those crustaceous animals, the barnacles, which made the good ships, Lightning and Swiftsure, (as Jack would say) move through the water like the stumps of trees.

In copper sheathing that is unprotected, the loose state of the particles of the oxidated surface, either prevent the shell fish from sticking fast, or the oxide may operate as an active poision and keep them off. We have observed the copper of a ship's bottom to be quite clean after a voyage, while the heads of the *cast metal* nails, have had a barnacle stuck upon each of them, as if they had been placed there by art, as ornamental white studs upon a green ground. These nails being in fact an *alloy of copper*, made with *tin* and *zinc*, the adhesion of the barnacles is accounted for. On the contrary, when nails made of *pure copper* are used, we have observed that the bar-

nacles show a decided aversion to them. Had sir H. Davy observed this fact, instead of ourselves, he would immediately have decided upon the utter inutility of the ingenious scientific experiments that have been made under his directions.

Founded upon the same theory of the galvanic influence, it has been reported, that a truly important discovery has been made; namely, that *iron* will not corrode, when "protected," in a similar manner to the copper, by zinc, and that a ship sheathed with iron and little bits of zinc, had been at sea for two years, returning home with a clean, and even bright surface. The discoverer is an American, who has communicated it to professor Pattison, and the consequence is a patent for these kingdoms, the specification of which we have perused, and annex its substance.

The proposed improvement consists in substituting sheets of iron with plates of zinc, attached thereto by rivetting or soldering, for the copper usually employed. The iron plates may be of the usual dimensions of the copper-plates, and for each area of 100 inches in the iron, a plate of zinc, of from $\frac{1}{8}$ to $\frac{1}{4}$ inch thick, equal to 5 inches in area, is attached to the lower extremity of the sheet, so that in sheathing the vessel from the upper part downwards, each succeeding sheet of iron shall be in contact, by lapping over, with the zinc plate of the sheet, immediately above it. Plates of zinc must also be attached to the inside of the sheet of iron, bearing a proportion in area to those on the outside, of 3 to 5. The spikes and bolts by which the sheathing is fastened to the vessel, are each to be furnished with a disc, or washer of zinc, fitting closely to the head, and it is recommended that they be driven *well home*, to ensure perfect metallic contact. The nails employed are to be made concave under the head, and the cavity is to be filled with melted zinc. The proportion of 5 square inches of zinc to 100 of iron, is not insisted on; any greater proportion will be equally effectual, and the zinc may be alloyed with copper, tin, or lead, in the proportion of from 3 to 10 per cent. By this mode of sheathing vessels, it is asserted that the corrosion or oxidation of the metal will be nearly, if not effectually, prevented.

Remarks by the Editor.—The American alluded to in the foregoing notice, is Dr. J. Revere, formerly of Baltimore, but now of the city of New York. This gentleman has been long and arduously engaged in a series of experiments, which have resulted in a complete conviction that perfect success will attend his mode of protection. The papers of Dr. Revere have been for some months deposited in the United States Patent Office, and all the requirements of the law have been complied with on his part, but the issuing of his patent has been delayed at his own request, to enable him to give the utmost precision to his specification. In the meantime, we presume that he has, by an agent, secured his right in England, under a conviction that it would be endangered by delay, as the laws of that country do not require that the patentee should be the inventor, and it has frequently happened that our citizens who have sent to Eng-

land to secure their patents, have found that some *confidential friend*, or active speculator, has been more on the alert than themselves.

We shall publish Dr. Revere's specification as soon as his patent is completed, and sincerely hope that his success may be such as amply to reward him for his indefatigable labours, and give to commerce and the arts, an improvement of inestimable value.

Memoir of the life of Joseph Fraunhofer, and of his great improvements in the Lenses for Achromatic Telescopes.

Of all the losses which science is occasionally called to sustain, there is none which she so deeply deplores as that of an original and inventive genius, cut off in the maturity of intellect, and in the blaze of reputation. There is an epoch in the career of a man of genuine talent, when he embellishes and extends every subject over which he throws the mantle of his genius. Imbued with the spirit of original research, and familiar with the processes of invention and discovery, his mind teems with new ideas, which spring up around him in rapid and profuse succession. Inventions incompleted, ideas undeveloped, and speculations immatured, amuse and occupy the intervals of elaborate inquiry, and he often sees before him, in dim array, a long train of discoveries which time and health alone are necessary to realize. The blight of early genius that has put forth its buds of promise, or the stroke which severs from us the hoary sage when he has ceased to instruct and adorn his generation, are events which are felt with a moderated grief, and throughout a narrow range of sympathy; but the blow which strikes down the man of genius in his prime, and in the very heart of his gigantic conceptions, is felt with all the bitterness of sorrow, and is propagated far beyond the circle on which it falls. When a pillar is torn from the temple of science, it must needs convulse the whole of its fabric, and draw the voice of sorrow from its inmost recesses. To those who have not studied the writings, or used the instruments, of the illustrious subject of this memoir, these observations may seem extravagant and inapplicable; but there is not a philosopher in Europe who will not acknowledge their truth, as well as their application; and there is not a practical astronomer within its widest boundaries, that has not felt the tide of grief for the loss of Fraunhofer flowing within his own circle.

Joseph Fraunhofer was born at Straubing, in Bavaria, on the 6th of March, 1787. His occupations in the workshop of his father, prevented him from giving a regular attendance at the public schools. At the early age of eleven, he was deprived of both his parents, and the person to whose charge he was entrusted, destined him for the profession of a turner; but his weak frame being ill suited to such an occupation, he was apprenticed to M. Weichselberger, manufacturer and polisher of glass, at Munich. Being too poor to pay any

thing to his master, he was taken on the condition that he should work for him six years without any wages.

At Munich, Fraunhofer frequented the Sunday school, but as his attendance was irregular, it was a long time before he learned to write or to count. In 1801, in the second year of his apprenticeship, an accidental circumstance gave a new turn to his fortune. Two houses having tumbled down suddenly, Fraunhofer, who lived in one of them, was buried under its ruins; but while others perished, he fortunately occupied a position to which it was considered practicable to open a passage. While this excavation was going on, the king, Maximilian, often came to the spot, to encourage the workmen and the young prisoner; and it was not till after a labour of four hours that they were able to extricate him from his perilous situation. His majesty gave directions that his wounds should be carefully attended to, and as soon as he had recovered, he was sent for to the palace to give an account of the peculiarities of his situation during the accident, and of the feelings with which he was actuated. On this occasion his sovereign presented him with eighteen ducats, and promised to befriend him in case of need.

Mr. Counsellor Utzschneider, afterwards his partner in the great optical establishment at Benedictbauern, took him also under his protection, and occasionally saw him. Fraunhofer, full of joy, showed him the king's present, and communicated to him his plans, and the way in which he proposed to spend the money. He ordered a machine to be made for polishing glass, and he employed himself on Sundays in grinding and finishing optical lenses. He was, however, often baffled in his schemes, as he had no theoretical and mathematical knowledge. In this situation M. Utzschneider gave him the mathematical treatises of Klemm and Tenger, and pointed out to him several books on optics. Fraunhofer soon saw, that, without some knowledge of pure mathematics, it was difficult to make great progress in optics, and he therefore made them one of the branches of his studies.

When his master saw him occupied with books, he prohibited him from using them, and other persons whom he consulted, did not encourage him to undertake the study of mathematics and optics without assistance, and at a time when he was scarcely able to write. These obstructions, however, served only to redouble the efforts of our author; and though he had no window in his sleeping chamber, and was prohibited from using a light, yet he acquired a considerable knowledge of mathematics and optics, and endeavoured to apply them to his own schemes.

In order to obtain more leisure, he employed the remainder of the royal present in buying up the last six months of his apprenticeship; and that he might gain some money for his optical experiments, he engraved visiting cards, without ever having been taught the art of engraving. Unfortunately, however, the war which then desolated Europe, put an end to the sale of his cards, and left him in greater exigencies than before.

Notwithstanding the kind assurances of protection which the king

had given him, Fraunhofer had not courage to request it, and he was, therefore, compelled to devote himself to the grinding and polishing of glasses, still continuing to devote his Sundays to the study of the mathematics.

Mr. Utzschneider was at this time seldom at Munich, and could do nothing for our young artist; but he recommended him to a professor of the name of Schiegg, well versed in mathematics and natural philosophy, who paid frequent visits to Fraunhofer.

About this time was formed the celebrated establishment at Benedictbauern, near Munich, by MM. Reichenbach, Utzschneider, and Leibherr, and in August, 1804, they began the manufacture of optical and mathematical instruments, which were divided by the new machine of Reichenbach and Leibherr. The whole of the apparatus was made there, excepting the lenses, for they could not procure good crown and flint glass, and wanted also a skilful optician. With this great defect, the establishment would certainly have failed, unless they had endeavoured to supply it.

Mr. Utzschneider now undertook a journey to make inquiry respecting crown and flint glass, and respecting a skilful working optician; but, after all his labours, he was convinced that the new establishment had no alternative but to form an optician within its own bosom. Through captain Grouner, of Berne, he had heard of the labours of Louis M. Guinand, an optician at Brenetz, in Neuchatel, and having received from him some specimens of his flint glass, he was so pleased with them that he paid a visit to Brenetz, and engaged Guinand to accompany him to Munich. As soon as he arrived there, which was in 1805, M. Utzschneider constructed furnaces for carrying on the experiments upon a well organized plan. The first attempt created much expense, on account of the repeated experiments which it required, but it nevertheless furnished several good pieces of both kinds of glass. The optician, Riggl, polished the first lenses in 1806 and 1807. At this period Fraunhofer found himself in a very critical situation. Professor Schiegg always encouraged him to go to M. Utzschneider, but Fraunhofer was long in resolving to do this, believing that the latter had forgotten him, and knowing that he was well satisfied with his own optician.

M. Utzschneider received Fraunhofer in a very friendly manner, and after a short conversation, it was agreed that he should also become an optician in the establishment. Fraunhofer was then employed to calculate and polish lenses of considerable dimensions, which came from the furnaces of Benedictbauern. These lenses were destined for the instruments of the observatory of Buda. It was afterwards agreed to transfer all the optical part of the establishment to Benedictbauern, and to give the complete direction of it to Fraunhofer. Our philosopher had already studied catoptrics, and had even written a memoir on the aberration which takes place without the axis in reflecting telescopes. He showed that hyperbolic mirrors are preferable to parabolic ones, and he also communicated the invention of a machine for polishing hyperbolic surfaces.

He now, however, resolved to give up this branch of the subject, as his time was fully occupied in the preparation of lenses.

One of the most difficult problems in practical optics, is, to give to spherical surfaces the last polish with that degree of exactness which theory requires, because this final operation destroys in part that form which had been previously given to the surfaces. M. Fraunhofer succeeded in remedying this evil by a machine which not only did not injure the fine surface obtained by grinding, but which actually corrected the irregularities committed in the first operation. It has also the advantage of making the result independent of the skill of the workman.

In examining the glass which he used in reference to the undulations and striæ which it contains, he found that, in the flint glass manufactured at Benedictbauern, there was often not a single piece free of those irregularities which disperse and refract the light falsely. Pieces of the same melting had not even the same refracting power, and this was, perhaps, more common in the English and French flint glass. After obtaining these results, Fraunhofer reconstructed the furnaces, procured the necessary instruments, and took the direction of all the meltings.

He had learned from experience, that flint glass could be made so that a piece at the bottom of the pot had exactly the same refractive power as a piece from the top; but his success was of short duration, for the succeeding meltings showed that this was merely accidental. Undaunted, however, by failure, he recommenced his experiments, in which he always melted four quintals at once, and after long and severe labours, he discovered the numerous causes which occasioned his want of success.

As the English crown glass had many undulations and impurities, Fraunhofer resolved to manufacture it also. Difficulties of a new kind here presented themselves, so that he did not partly succeed till after a whole year's labour. He found, also, that with whatever degree of accuracy he followed the theory in the construction of achromatic object-glasses, his expectations were never realized. On the one hand, he was convinced that it was wrong to neglect certain quantities, such as the thickness of the lens and the higher powers of the apertures, merely to obtain commodious formulæ; and on the other hand, there was no exact method for determining the exponents of refraction and dispersion, in the glass used for achromatic object-glasses. The first of these inconveniences he avoided by a new method, in which he neglected no quantity upon which the required degree of exactness depended. Hitherto, achromatic object-glasses had only been calculated for rays proceeding from a point in the axis of the lens, but Fraunhofer considered the deviations from all points situated without the axis, and this is always a minimum in his object-glasses. In this consists principally the difference between his glasses and those made in England.

The difficulty hitherto experienced in determining the refractive and dispersive powers of bodies, arises chiefly from the circumstance that the spectrum has no definite termination, and that the passage

from one colour to another, was so gradual and indistinctly marked, that in large spectra the angles could not be measured with a greater accuracy than from ten to fifteen minutes. In order to avoid this inconvenience, Fraunhofer succeeded, by a very ingenious contrivance, in obtaining homogeneous light of each colour in the spectrum. In these experiments, he discovered in the orange compartment of the spectrum, produced by the light of the fire, a bright line, which he afterwards found to exist in all spectra, and by means of which he was enabled to determine the refractive powers of the bodies which produced them.

By using prisms entirely exempt from veins,—by carefully excluding all extraneous light, and even stopping those rays which formed the coloured spaces that he wished to examine, he discovered that the spectrum was intersected by a great number of black lines parallel to one another, and perpendicular to its length.* In the spectra formed by all solid and fluid bodies, he not only discovered the same lines, (of which he has reckoned five hundred and ninety in all,) but he found that they had fixed positions, and that the distances between them in different spectra, afforded precise measures of the action of the prism on the rays which formed the corresponding coloured spaces. The valuable memoir in which these discoveries are consigned, was published in the fifth volume of the *Memoirs of the Academy of Munich*, for 1814 and 1815, and also in a separate pamphlet entitled *Bestimmung des Brechungs, und Farbenzerstreuungs, Vermogens verschiedener Glasarten.* The writer of this notice had the satisfaction of first translating this memoir into English, and of publishing an abstract of its results in the article *Optics*, in the Edinburgh Encyclopædia.

About this time, in 1817, Fraunhofer was elected a member of the Academy of Bavaria, of which he was an active supporter.

On speculating on the cause of the dark lines of the spectrum, our author was led to consider them as arising from the interference of the rays, and he was induced to make a complete series of experiments on the inflexion of light. These experiments he published in the eighth volume of the *Memoirs of the Academy of Munich*, under the title of *Neue Modefikation des Lichtes durch gegenseilige Einwirkung und Beugung der Strahlen und gesetze derselben.* In these experiments, of which we have given a full account in the article *Optics*, in the Edinburgh Encyclopædia, Fraunhofer employed a heliostate for giving a fixed direction to the solar ray, and he examined all the phenomena through a telescope mounted upon a large theodolite, by means of which he measured the deviation of the inflected light. The object-glass was twenty lines in diameter; its focal length was 16.9 inches, and its magnifying power from 30 to 110. The heliostate was placed thirty-eight feet seven and a half inches, French measure, from the centre of the theodolite. The diameters of the apertures were measured by a micrometer micro-

* About twenty years ago, lines were discovered in the spectrum, by Dr. Wollaston. See *Phil. Trans.* 1802.

scope, which showed distinctly the *two hundred thousandth part of an inch*, and sometimes even half that quantity. All the phenomena which he thus observed and measured, he considered to be perfectly explicable on the undulating system, with certain modifications; and upon these principles he afterwards constructed a general analytical formula, to express these new laws of light. From this formula, it followed that these phenomena would be modified in a manner not only singular, but apparently extremely complicated, if a number of parallel lines could be made so fine, that eight thousand of them were contained in one inch. After another set of experiments, he invented a machine, by means of which he could construct these systems of lines with that accuracy which the theory required. The details of these experiments were read before the Academy of Munich, on the 14th June, 1823, and will be found in this and the subsequent number of this (Brewster's) *Journal*.

M. Fraunhofer, likewise, applied himself to the study of various atmospheric phenomena, such as halos, parhelia, &c., which he published in professor Shumacher's *Astronomische Abhandlungen*, and of which we have given a notice in the last number of this *Journal*, p. 348. (See Brewster's Journal, No. 12.)

Such is a brief sketch of the scientific researches of Fraunhofer, but, valuable though they be, they are in no respect to be compared with his practical labours as an optician. His minor inventions are a new *Heliometer*, a *repeating wire Micrometer*, and an improved *annular Micrometer*. The principal instruments which he has made, are the great parallactic telescope, constructed for the observatory of Dorpat, and of which we have given a full description and a drawing, in No. iv. p. 306, of this *Journal*. The prime cost of this instrument was £950. Its aperture is *nine* inches, and its focal length 13½ feet. His next great work was another achromatic telescope, ordered by the king of Bavaria, and which has an object-glass *twelve inches* in diameter, and eight feet in focal length, but it is not yet completed. Although engaged in works of such magnitude, Fraunhofer was at the same time carrying on others on a less scale, though not of less importance to science. The Astronomical Institution of Edinburgh, in the year 1825, ordered from him a very large and complete transit instrument, with a telescope eight feet and a half in focal length, and six inches aperture. Upon the receipt of this order, he constructed three object-glasses of these dimensions, one for the Royal Observatory of Edinburgh, another for a heliometer for M. Bessel, and a third as a spare one in case M. Bessel's object-glass should meet with any accident in the bisection; and, fortunately for science, these object-glasses are all completed.

In the year 1820, when M. Reichenbach left the copartnery, MM. Utzschneider and Fraunhofer entered into a new contract for continuing their optical establishment. The former presented to Fraunhofer a share in the concern, equal to about 24,000 francs, so that, from having several other sources of income, he was now comfortable and independent. Inspired by his success and good fortune, all the activity of his mind was called forth, and he took the esta-

blishment entirely under his direction. Since 1817, it had been transferred to Munich, and the business had increased to such a degree, that *fifty* workmen are at present employed.

In 1823, M. Fraunhofer was appointed keeper of the physical cabinet of the academy of Munich, a situation to which a pension was attached. In 1824, after the public exhibition of the great telescope of Dorpat, the king of Bavaria honoured him with the rank of a chevalier of the order of Civil Merit. He was also elected a member of several foreign societies, among which we may mention the Society of Arts in our own city. The university of Erlangen also conferred upon him the title of Doctor in Philosophy.

Thus honoured and respected both at home and abroad, Fraunhofer was enjoying all the happiness which character and reputation and a moderate independence never fail to yield. His mind was occupied with great views of scientific ambition, which he could not have failed to realize, and such was the perfection to which he had brought his art, that he was willing to undertake an achromatic telescope, with an object-glass *eighteen inches in aperture*, and we have now before us a letter in which he fixes even the price of this stupendous instrument. But he was not destined to accomplish so great an undertaking. In October, 1825, he was attacked with a pulmonary complaint, from which he never recovered. The injury which he sustained by the fall of his house, seems to have left some effects behind it, and for several years he had suffered from glandular abscesses. He was, however, seldom obliged to discontinue his labours, and there is reason to think that he suffered from exposure to the heat of his furnaces. His faculties never for a moment left him; and in his few last days, his mind was occupied with the idea of a journey to France and Italy, for the recovery of his health. He was cut off on the 7th June, 1826, in the fortieth year of his age. A few days before this event, he had received from the king of Denmark, the diploma of chevalier of the order of Dannebroga. The whole of the city of Munich took a lively interest in his disease, and felt the most sincere sorrow for his death. The magistrates of the city permitted M. Utzschneider to choose a place for his tomb, and he was interred by the side of the great mechanician, M. Reichenbach, who had died a short time before.

Bavaria has thus lost one of the most distinguished of her subjects, and centuries may elapse before Munich receives within her walls an individual so highly gifted and so universally esteemed. But great as her loss is, it is not rendered more poignant by the reflection that he lived unhonoured and unrewarded. His own sovereign, Maximilian Joseph, was his earliest and his latest patron, and by the liberality with which he conferred civil honours and pecuniary rewards on Joseph Fraunhofer, he has immortalized his own name, and added a new lustre to the Bavarian crown. In thus noticing the honours which a grateful sovereign had conferred on the distinguished improver of the achromatic telescope, it is impossible to subdue the mortifying recollection, that no wreath of British gratitude has yet adorned the *inventor* of that noble instrument. England

may well blush when she hears the name of Dollond pronounced without any appendage of honour, and without any association of gratitude. Even that monumental fame which she used to dispense so freely to the poets whom she starved, has been denied to this benefactor of science, and Westminster Abbey has not opened her hallowed recesses to the remains of a man who will ever be deemed one of the finest geniuses of his age, and who had exalted that genius by learning and piety of no ordinary kind.

Thus neglected and mortified, it is not a matter of surprise that this branch of science and of art should seek for shelter in a more hospitable land, and that the pre-eminence which England has so long enjoyed in the manufacture of the achromatic telescope, should be transferred to a foreign country. The loss of Fraunhofer holds out to us an opportunity of recovering what we have lost, and we earnestly hope that the Royal Society of London, and the Board of Longitude, will not allow it to pass. Great Britain has, hitherto, left the sciences and the arts to the care of individual enterprise, and to the patronage of commercial speculation; but now, when all Europe has become our rivals, when every sovereign, like the Ptolemies of old, is collecting round his throne, the wisdom even of foreign states, is it not time that she should start from her lethargy, and endeavour to secure what is yet left? The British minister who shall first establish a system of effectual patronage for our arts and sciences, and who shall deliver them from the fatal incubus of our patent laws, will be regarded as the Colbert of his age, and will secure to himself a more glorious renown than he could ever obtain from the highest achievements in legislation or in politics. [*Brewster's Journ.*

On the Means of preserving Birds for Cabinets of Natural History.

By Charles Waterton, Esq.

Abstracted from "Wanderings in South America."

(Concluded from page 36.)

It is now time to introduce the cotton for an artificial body, by means of the little stick, like a knitting needle, and without any other aid or substance than that of this little stick and cotton; your own genius must produce those swellings and cavities, that just proportion, that elegance and harmony of the whole, so much admired in animated nature, so little attended to in preserved specimens. After you have introduced the cotton, sew up the orifice you originally made in the belly, beginning at the vent, and from time to time, till you arrive at the last stitch, keep adding a little cotton, in order that there may be no deficiency there. Lastly, dip your stick into the solution, and put it down the throat three or four times, in order that every part may receive it. When the head and neck are filled with cotton, quite to your liking, close the bill as in nature. A little bit of bees' wax at the point of it will keep the mandibles in their proper place. A needle must be stuck in the lower mandible

perpendicularly. You will shortly see the use of it. Bring also the feet together by a pin, and then run a thread through the knees, by which you may draw them to each other, as near as you judge proper. Nothing now remains to be added but the eyes. With your little stick make a hollow in the cotton within the orbit, and introduce the glass eyes through the orbit. Adjust the orbit to them as in nature, and that requires no other fastener.

Your close inspection of the eyes of animals will already have informed you, that the orbit is capable of receiving a much larger body than that part of the eye which appears within it when in life; so that were you to proportion your eye to the size the orbit is capable of receiving, it would be far too large. Inattention to this has caused the eyes of every specimen in the best cabinets of natural history, to be out of all proportion. To prevent this, contract the orbit, by means of a very small delicate needle and thread, at that part of it farthest from the beak. This may be done with such nicety, that the stitch cannot be observed, and thus you have the artificial eye in true proportion.

After this, touch the bill, orbits, feet, and former oil gland, at the root of the tail, with the solution, and then you have given to the hawk every thing necessary, except attitude, and a proper degree of elasticity, two qualities very essential.

Procure any common ordinary box, fill one end of it, about three-fourths up to the top, with cotton, forming a plane. Make a moderate hollow in it to receive the bird. Now take the hawk in your hands, and, after putting the wings in order, place it in the cotton, with its legs in a sitting posture. The head will fall down: never mind, get a cork, and run three pins into the end, just like a three-legged stool. Place it under the bird's bill, and run the needle, which you formerly fixed there, into the head of the cork. This will support the bird's head admirably. If you wish to lengthen the neck, raise the cork, by putting more cotton under it. If the head is to be brought forward, bring the cork nearer to the end of the box. If it requires to be set backwards on the shoulders, move back the cork.

As in drying, the back part of the neck will shrink more than the fore part, and thus throw the beak higher than you wish it to be, putting you in mind of a star-gazing horse, prevent this fault by tying a thread to the beak, and fastening it to the end of the box with a pin or a needle. If you choose to elevate the wings, do so, and support them with cotton; and, should you wish to have them particularly high, apply a little stick under each wing, and fasten the end of them to the side of the box with a little bees' wax.

If you would have the tail expanded, reverse the order of the feathers, beginning from the two middle ones. When dry, replace them in their true order, and the tail will preserve for ever the expansion you have given it. Is the crest to be erect? move the feathers in a contrary direction to that in which they lie, for a day or two, and it will never fall down after.

Place the box any where in your room, out of the influence of the sun, wind, and fire; for the specimen must dry very slowly if you

wish to re-produce every feature. On this account the solution of corrosive sublimate is uncommonly serviceable; for at the same time that it totally prevents putrefaction, it renders the skin moist and flexible for several days. While the bird is drying, take it out, and replace it in its position once every day. Then, if you see that any part begins to shrink into disproportion, you can easily remedy it. The small covert feathers of the wings are apt to rise a little, because the skin will come in contact with the bone which remains in the wing. Pull gently the part that rises, with your finger and thumb, for a day or two. Press the feathers down. The skin will adhere no more to the bone, and they will cease to rise.

Every now and then touch and re-touch all the different parts of the features, in order to render them distinct and visible, correcting at the same time any harshness or unnatural risings or sinkings, flatness or rotundity. This is putting the last finishing hand to it.

In three or four days the feet lose their natural elasticity, and the knees begin to stiffen. When you observe this, it is time to give the legs any angle you wish, and arrange the toes for a standing position, or curve them to your finger. If you wish to set the bird on a branch, you can, in a moment, transfer the bird from your finger to it, and from it to your finger at pleasure.

When the bird is quite dry, pull the thread out of the knees, take away the needle, &c. from under the bill, and all is done. In lieu of being stiff with wires, the cotton will have given considerable elasticity to every part of your bird; so that, when perching on your finger, if you press it down with the other hand it will rise again. You need not fear that your hawk will alter, or its colours fade. The alcohol has introduced the sublimate into every part and pore of the skin, quite to the roots of the feathers. Its use is twofold. 1st. It has totally prevented all tendency to putrefaction; and thus a sound skin has attached itself to the roots of the feathers. You may take hold of a single one, and from it suspend five times the weight of the bird. You may jerk it, it will still adhere to the skin, and after repeated trials often break short. 2ndly. As no part of the skin has escaped receiving particles of sublimate contained in the alcohol, there is not a spot exposed to the depredation of insects; for they will never venture to attack any substance which has received corrosive sublimate.

You are aware that corrosive sublimate is the most fatal poison to insects that is known. It is anti-putrescent; so is alcohol; and they are both colourless, of course they cannot leave a stain behind them. The spirit penetrates the pores of the skin with wonderful velocity, deposits invisible particles of the sublimate, and flies off. The sublimate will not injure the skin, and nothing can detach it from the parts when the alcohol has left it. All the feathers require to be touched with the solution, in order that they may be preserved from the depredation of the moth. The surest way of proceeding is to immerse the bird in the solution of corrosive sublimate, and then dry it before you begin to dissect it. Furs of animals, immersed in this

solution, will retain their pristine brightness and durability in any climate.

Take the finest curled feather from a lady's head, dip it in the solution, and shake it gently till it be dry; you will find, that the spirit will fly off in a few minutes, not a curl in the feather will be injured, and the sublimate will preserve it from the depredation of the insect. Perhaps it may be satisfactory to add here, that some years ago, I did a bird upon this plan in Demarara. It remained there two years. It was then conveyed to England, where it stayed five months, and returned to Demarara. After being four years more there, it was conveyed back again through the West Indies to England, where it has now been near five years, unfaded and unchanged.

On reflecting that this bird has been twice in the temperate and torrid zones, and remained some years in the hot and humid climate of Demarara, only six degrees from the line, and where almost every thing becomes a prey to the insect, and that it is still as sound and as bright as when it was first done, it will not be thought extravagant to surmise, that this specimen will retain its pristine form and colours for years after the hand that stuffed it has mouldered into dust. Little more remains to be added, except that what has been penned down with regard to birds, may be applied, in some measure, to serpents, insects, and four-footed animals.

Account of French Patents.

French patent, for Five Years, from 9th April, 1822. *Granted to* Messrs. Gros *and* Gessionne, *of Paris, for methods of applying Lithographic Subjects on Bags, Pouches, Souvenirs, &c.*

These methods consist in taking any sort of skin whatever, such as those of calves and sheep, Morocco, or varnished, as sold in commerce without any other preparation. These skins are cut into pieces of a size suited to the object desired to be obtained. On every piece, any subject or drawing whatever is painted, lithographed, or engraved separately, and left in black, or coloured afterward at pleasure.

For painting the subjects, such as flowers and landscapes, and for colouring the lithographs and engravings, mineral and vegetable colours ground up with oil, essence of turpentine and other essential oils, and with water, are employed. A spirit of wine varnish is applied afterward, and dried by a moderate fire, or in sunshine. The object of this varnish, is, to preserve the painting, to prevent it from being rubbed off, and to render it very solid and impermeable.

French patent, for Five Years, from 7th June, 1822. *Granted to* GILLES RENE, *Manufacturer, Paris, for the Composition of a Substance fit for Preserving Packing Cloths, Thread, Ribands, as well as Cords and Cordage of every kind, from damp or humidity.*

THIS composition is obtained by melting together over the fire, one pound of elastic gum, one pound of bituminous tar, two pounds of linseed oil, one pound of fat oil, and half a pound of litharge.

When the whole is melted, take it off the fire, for fear of accident, and add half a pound of essence (spirits of turpentine.)

Patent for improvement and additions. November 6th, 1823.

For the addition of new materials to the preceding composition.

Instead of making the composition as above stated, do it in the manner following:—

First, melt together over the fire, one pound of elastic gum, (Indian rubber,) one pound of bituminous tar, two pounds of linseed oil, one pound of fat oil, half a pound of litharge, one pound of salt of saturn, one pound of alum, and one pound of manganese.

Take it off the fire, as before, and add half a pound of essence (oil of turpentine.)

French patent, for Five Years, from 21st September, 1822. *Granted to* MICHEL SCHELHEIMER, *of Paris, for the invention of a process of Painting under Plate-Glass, (sous glace) and Common Glass, applicable to optical mirrors.*

THE colours in use in this kind of painting, are, mineral silver-white, mineral chrome yellow, Prussian blue, soot-black, vegetable rose-coloured carmine, mineral vermilion red, and mineral umber earth: all these colours are ground in fat varnish.

When the subject has been drawn, the painting is begun with the tints of light, which are made with white, yellow, carmine, blue, and gamboge yellow (*gomme gutte,*) which are transparent colours.

To represent a butterfly, for example, all the transparent colours are applied according to the proper gradations, and we finish with the darker colours, to bring out the light tints.

If it be a rose we intend painting, a very light tint is laid on first, and the shades are laid on afterward, with darker carmine.

For all subjects, such as flowers, fruits, birds, butterflies, arabesques, &c. we always begin with the transparent colours, and finish with the suitable dark shades.

To compose the green colours, Prussian blue and chrome yellow are mixed together in quantities, depending on the shade required.

When it is desirable to throw certain lights into the work, they

are scratched out by means of an iron point, especially in the green leaves requiring high finishing.

After the painting is applied, we lay on a course of silver-white, ground with gum and water.

With respect to plate glass and mirrors, when painting is applied upon them, they are tinned or silvered afterward, as usually done for other objects of this kind.

French patent, for Five Years, from 27th September, 1822. *Granted to* M. Michon, Sen. *of Melun, (department of the Seine and Marne,) for the invention of methods of making men and women's Hats of Plaited Straw, Twigs, and Whalebone, without seam.*

These hats are formed of a tissue, the chain of which is of whalebone, made thin by means of a sort of plane, composed of a piece of wood 3 inches long by 2 inches wide, in which a sharp plane-iron is lodged.

The shoot, weft, or filling, is of twigs or of straw. The twigs are split according to the form intended to be given to the texture, and are prepared in the same manner as the whalebone. As for the straw, it is split by means of an ivory or steel knife.

The hats are made by hand upon wooden forms, and when they are terminated, those which are intended for men are dyed black or gray, and those for women remain undyed. Women's hats are most commonly filled with straw, or with ends of ears, (*bouts d'épis.*)

The same process may be followed for preparing *shakos* for the use of soldiers.

Improvement and addition, 28th December, 1822. *Granted to* A. De Barnardiere, *Assignee of Michon's Patent.*

These improvements consist in introducing, in the preceding mode of manufacturing, the method of weaving twigs in flat breadths (*éclisses*) of making hats with a shoot of willow plait, or poplar, or generally of every sort of green or dry wood; and, lastly, of the application of these different tissues to the preparation of shakos, and other head dresses, as well for the civil as the military.

As to the preparation of the different raw materials, that is precisely the same as in the patent granted to Monsieur Michon.

French patent, for Five Years, from 31st July, 1823. *Granted to* M. Boullay, *Cutler to the Royal Veterinary School of Alfort, for a Method of Manufacturing Razors, with economy and despatch. Annulled by Ordinance of the King, September* 16, 1825.

Process.—The razor blades, prepared at one heat, are cut out by a fly-press and a matrix.

The backs of the razors are of iron or steel wire, cut of the length of the back of the blades, which requires no alteration. The groove in which the blade is fitted is made with a countersink, and one heating is afterwards given to the heel.

By these means a razor may be completed in an hour, will come much cheaper than those which are made by the usual methods, and may be of a cast steel of the best quality.

French patent, for ten years, from 24th January, 1818. *Granted to* Messrs. Michaud, Labonte & Depuis, *of Paris, for the invention of a method of Plating Copper* (cuivre) *with Platina.*

Take 123 grammes (= 1899·6 grains) of fine silver, which you are to prepare for solution by the addition of 490 grammes (= 7567·6 E. grains) of nitric acid at 48°. (= 1·50 specific gravity, at 55°. F.): introduce them into a matrass, and expose it on a sand-bath over a continued fire, till the silver is perfectly dissolved.

Afterward prepare, in a porcelain capsule, 490 grammes of white tartar, and the same quantity of marine salt. When these substances have been pulverized together, pour the solution into the capsule, and stir the whole with a wooden spatula, till a perfect mixture is obtained. This composition is used for preparing the copper intended to be plated: for this purpose, the copper is first cleaned, and this composition is afterwards applied to it to whiten it. This application being made, with the assistance of a flat and very clean piece of cork, upon the metal, the latter is afterwards enveloped by a leaf of virgin silver, and exposed to the action of a well-closed air-furnace. Let it heat to a degree above cherry red. Apply, by means of a burnisher, and rub on the plate without taking it out of the furnace, and this will apply the substance on the copper-plate. When the whole forms only one body, pass it between laminating rollers, to give it the consistency of a solid body. This first operation terminated, the leaf of platina is prepared of the proper size for the copper-plate intended to be covered, so as to envelop it, and both are cleaned with sand, to remove any grease they may have on them, and dried with clean linen, that there may be no moisture remaining. The copper is then enveloped by the platina foil, in the same manner as it was before enveloped by the leaf of virgin silver, and submitted to the action of the same furnace as before, rubbing also in the same way with the burnisher, which applies the platina.

ENGLISH PATENTS.

Patent granted to Thomas Revis, *Watch-maker, for an improved method of Lifting Weights.* Dated July 10, 1828.

In the specification of this patent an apparatus is described of the

nature of a windlass, that is worked by a lever moved upwards and downwards alternately, and is so contrived as to have its barrel, or cylinder, (on which the acting cord or chain is wound up,) turned round always in the same direction by that movement.

This apparatus consists of the barrel mentioned, sustained horizontally on an adequate axle in the usual manner, parallel to which, two other axles are supported on the same frame work, having toothed wheels at their opposite ends; two of these are fixed to the axles, and interlock with each other, while the two others turn loosely on them, but interlock with another toothed wheel, that is fixed to the axle of the barrel at the same side of the frame; close to each of the loose wheels a ratchet wheel is fixed to the same axles, and four spring catches being fastened, at equal intervals asunder, to the sides of each of the loose wheels, in contact with the ratchets, on one of the axles being turned, (by raising a lever, fixed to a part of it that projects beyond the frame for that purpose,) the ratchet wheel on its other end passes by the four catches on the adjoining loose wheel to take a more advanced gripe; while the other parallel axle being at the same time turned by it in the opposite direction, by means of its fixed wheel, its ratchet wheel is thereby moved round against the direction of the catches on its loose wheel, which latter consequently becomes attached to it, and being thereby made to revolve along with the axle, it acts on the toothed wheel of the barrel, and causes it to wind up a portion of its cord or chain.

On the other hand, when the lever is depressed, the ratchet of the primary axle presses against the catches of its loose wheel, and causes the latter to act on the toothed wheel of the barrel, so as to make it revolve in its original course, while the ratchet of the secondary axle passes by the catches of its loose wheel, and advances forward preparatory to the next reversed movement of the lever: by this means the barrel continually revolves the same way, while the lever is moved up and down; being only subject to a momentary suspension of motion, while the direction of the lever is being changed.

As for several purposes, it is desirable that weights should be lowered safely by the apparatus, as well as raised; this is effected by a common resisting or friction wheel, over which a band passes, attached to the main axle, capable of being pressed down forcibly by a lever affixed at one extremity; and the primary moving axle being constructed so as to slide a small space laterally, when pressed by a third lever, fixed close to it in the frame for that purpose, this operation causes its fixed wheel to pass beyond that of the secondary axle, and its loose wheel beyond the fixed wheel of the barrel, so that the latter, becoming thus disengaged from the other machinery, is only restrained by the resisting or friction wheel; which the lever attached to its band easily regulates, so as to permit it to recoil, and let its cord be drawn off by the descending weight with a duly restricted degree of velocity.

The primary lever is balanced by a weight on an arm, that projects from it at the opposite side of the axle, to make its action more uniform, particularly in heavy machinery.

Obs.—This apparatus is calculated for raising weights of a magnitude, to which the common winches on the axles of cranes would not be adequate; and in our opinion, the levers (which alone can therefore be applied on such occasions) are made in it to produce a continuous motion, equal in all respects to that produced by winches, in a very ingenious and effectual manner. And we think that windlasses made on this principle would be very serviceable in ships, when furnished with more levers (easily added to the several ends of the axles) and with cross bars, to admit several men to operate on them simultaneously.—[*Repertory.*

Patent Granted to John Hawks, *Iron Manufacturer, for an improvement in the construction of Ships' Cable-Chains, and Hawser Chains.* Dated July 10, 1828.

This improvement consists in making the extremities of the links of those chains, where they touch each other, considerably thicker than their sides, so as to render them more durable than common links.

Links of this kind are to be made by forming bars of iron, or other proper metal, with thicker projecting parts at such regular intervals from each other, as the size of the intended links demands, either by means of rollers, properly constructed, or by swageing, or stamping, and then cutting them obliquely in the middle between every second pair of projections, bending these pieces round into the form designed, and after that, welding their obliquely-cut ends, brought together so as to form one of the sides of each link; all which operations are to be performed by the usual tools and methods.

The patentee states, that links of this kind may be made with, or without *stays*, whichever is preferred; these stays consist of pieces, passing across the shorter diameters of the links from side to side, for the use of which a patent was formerly obtained, that is probably since expired.

Obs.—We think the mode of forming links for chains, for which this patent has been granted, to be a very obvious and beneficial improvement, when these are of an oval form; as it is evident, that links of this shape must be much more liable to wear at the extremities of the longer axle of their ovals, where they rub against each other, than in any other part, and that therefore, the making those parts of contact thicker than the rest, must cause them to last proportionably longer, and that chains composed of such links will be also stronger and more safe than those of the ordinary construction.

It also appears to us, that a secondary advantage, not noticed by the patentee, will arise from this method of forming the links; proceeding from their being necessarily welded at their sides, instead of

at one of their ends or smaller bends, as is customary in making common chains; which alteration, in our opinion, will also make them much stronger, since the welded part will be in general the weakest part of the link, and the forming this connexion in the side where they are least liable to wear or strain, will produce the effect mentioned, as the resistance from the hooked part of the link to be drawn straight, would in many cases preserve its connexion to those adjoining, even if the welding had failed, so as to have little or no strength.

The stays mentioned by the patentee, we think, had better be omitted in all cases; since they add very nearly a sixth (on a rough computation) to the weight of the link (which in the cable-chain for a man-of-war would amount to a considerable tonnage,) without affording any proportional strength; their only effect being to resist the approach of the sides of the link to each other, that great strains might have a tendency to cause, by drawing its ends farther asunder; which is prevented, without the stay, by the insertion of the portions of the other links that pass through its cavity, while at the same time the oval shape of the link causes the tendency to this accident to be of a very small magnitude.—[*Ib.*

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS GRANTED IN APRIL, 1829.

With Remarks and Exemplifications, by the Editor.

[Concluded from page 58.]

45. For an improvement in the mode of *Measuring and Cutting Boots;* Thomas Howe, Worcester, Massachusetts, April 18.

The boots are to be cut by using metal patterns, of which there are two, made in the shape of the common "crimping forms" used by boot-makers. These patterns are graduated, so that by the same guide the largest and the smallest boot can be cut. To effect this, holes are drilled near to, and at equal distances from, each other, extending inwards from the cutting edge of the pattern, of which holes there are several rows, which serve to mark the leather for placing the pattern to cut according to the size required.

A strap, properly divided, is used to obtain the measure of the foot.

"All I claim in my improvement, is, the holes drilled in the patterns, by means of which boots of the largest as well as the smallest sizes may be cut with one set of patterns."

"The advantages to be derived from my improvement consist in the saving of time, in cutting and fitting the boot to the foot more exactly, and with greater certainty, nothing being left to the judgment, as by the common method; in the fact, that any cobbler may cut a boot that will fit, with the same exactness as that cut by the most skilful in the art."

46. For an improvement in the common *Wool Carding Machine*, in making an endless or perpetual roll, by means of a circular, or transverse doffer; Charles Atwood, Middletown, Middlesex county, Connecticut, April 18.

(See specification.)

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47. For an improvement in the *Cylinder Paper Machine;* Isaac Saunderson, Milton, Norfolk county, Massachusetts, April 18.

A general defect in the paper made upon cylinder machines, is, the inequality of its strength when tried lengthwise and across. This is in consequence of a greater number of fibres running in one direction than in the other, and a consequent want of that perfect interlocking which takes place upon mould-made paper. A part of the present machine is intended to remove this defect. For this purpose there is a "*horizontal whirl wheel*, which plays or revolves under the wing cylinder, so called, upon which the paper forms, and by distributing the current and counteracting the continuous motion of the pulp rising upon the cylinder, improves the quality, and increases the strength of the paper, by casting the fibrous parts of the pulp in every direction, and at the same time throwing the knots and motes on the outward surface of the sheet, (instead of depositing in the body of the paper) from which they can easily be removed without injury to the paper."

The other improvement is "the *sheet forming roller;* this roller is used, and put in the place of the *upper water pressing roller* (so called) of the cylinder paper machines. The sheet is formed on this roller, the circumference of which must be graduated according to the dimensions of the sheet required. The additional kinds of paper that can be made on the cylinder paper machine, by means of the improvement, or invention, of the *sheet forming roller*, and the *counteracting horizontal whirl wheel*, are, press paper, bonnet paper, pasteboard, and band-box paper."

There are eight floats on the horizontal whirl wheel, which are placed obliquely, the more perfectly to agitate the water. The whirl wheel and sheet forming roller constitute the claim.

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48. For an improvement in the mode of manufacturing *Seine Twine, and other Small Cordage*, by machinery, at one operation, called "Pond's Cotton Twine Machine;" Alson Pond, Petersburg, Virginia, April 21.

A machine to perform operations so complex, cannot be understood excepting by drawings with references. The machine in question appears to be as simple as its various operations will admit; and should we learn that, upon trial, it is superior to others intended for the same purpose, we will hereafter recur to it.

There are other patents for laying and twisting at one operation,

but the present does not appear to interfere with any which we have seen. The whole machinery, as applied, is claimed.

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49. For an improvement in the *Paddle Wheels of Steam Boats*, or wheels applicable to other objects, to prevent what is called "back water;" Paul Boynton, Ogdensburg, St. Lawrence county, New York, April 21.

This is a wheel, upon the contrivance of which much thought has been spent, as its construction fully manifests. Its intention is to preserve a vertical position in the buckets of a paddle wheel. Many patents have been procured for this object, and we have before taken occasion to express an unfavourable opinion of the whole of them; not merely on account of their complexity, but because we believe that if the end could be attained without a multiplication of moving parts, it would offer but little, if any, advantage beyond the ordinary paddle wheel.

The present plan is certainly not less complex than some of its predecessors. To move ten buckets there are not many less than 200 moving parts, and this certainly would present some objection both in point of cost, and in liability to derangement.

In several of the plans alluded to, one general principle prevails. The buckets, or floats, have on each end two pivots, inserted into the rims of eccentric wheels, the rims being of equal size, and having their centres one as far below the other as the distance between the two pivots on one end of a bucket. An arrangement of this kind will keep all the buckets vertical throughout their whole revolution. Although the plan before us differs considerably from this, yet a little analysis brings it back to an analogous, if not the same principle.

How far this scheme will obviate back water, we cannot now discuss, but will make a single remark on the subject. Suppose the paddle wheel immersed to the centre of the shaft, the last dipping and rising buckets would then have no horizontal motion whatever, but would offer the same resistance as would a flat board of the same size, fixed to the side of the boat with its surface exposed to the water.

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50. For a *Cylinder Hemp and Flax Machine;* James Y. Watson, John Blossom, and Andrew Burnet, Salem, Washington county, New York, April 21.

This machine is intended for breaking hemp and flax, either before or after being water rotted. Two hollow cylinders, three feet long and four or five feet in diameter, are placed to revolve horizontally, one above the other, and in opposite directions. Their peripheries are fluted, or reeded, and touch each other within half an inch. Each cylinder is surrounded, for nearly two-thirds of its surface, with rollers of four inches diameter, very nearly touching each other, and approaching the large cylinder within one-fourth of an inch. The rollers are capable of receding by the agency of springs,

by which they are borne up. These rollers extend from the top of the upper cylinder, as nearly as possible to its junction with the lower cylinder, which lower cylinder is surrounded by small rollers in like manner, but upon the opposite side.

A feeding apron like that of a carding machine, supplies the upper roller, and a receiving table, or apron, below the lower roller, conducts the material off after it has passed through the rollers.

The machinery must be properly geared, and may be turned by any sufficient power.

The arrangement of the fluted rollers and cylinders, and the steel springs by which the rollers are borne up, form the substance of the claim.

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51. For a *Moveable Cider Mill and Press;* Moses B. Bliss, Pittstown, Kennebec county, Maine, April 21.

(See specification.)

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52. For a machine for *Slitting Tenons, Veneers, &c.*, called the "Vertical Tenoner," and intended for shop purposes; John M'Clintic, Chambersburg, Franklin county, Pennsylvania, April 21.

This machine is furnished with a vertical, and also with a circular saw, either of which may be put in gear, and used. A carriage running upon rollers, receives the piece which is to be tenoned; this carriage has a table framed across it, regulated by a *tail screw*, so as to set the piece to be sawed, without the necessity of gauging. For all but very heavy work, the carriage is drawn up by a weight and pulley; there is a rag wheel, however, which may be used when necessary. The claim is as follows: "running the driving shaft on points, also my plan of fly wheel, also the manner of [fixing the] tail screw, or table, preventing the necessity of gauging, and producing perfect uniformity of tenon, with but little care."

The cases are numerous in which patentees are at a fault to tell what to claim as new in their machines, especially where ingenuity has tortured an instrument into almost every variety of form, for the purpose of obtaining an exclusive right. There are several machines for tenoning, for which patents have issued, the essential parts of which appear to us similar to that in question; and there are in our country ten thousand workmen, who, if required, could make a machine equally suitable for this purpose, without having seen either; and, after all this had been done, there would be very little of *invention*, properly so called, in the whole; but merely a condensation of larger machines, and an adaptation of parts of them to the particular purpose in view.

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53. For a new and useful machine for *Planing Floor Plank, and Grooving and Tongueing, and Straightening the edges of the same*, planing boards, straightening and planing square

timber, &c. &c., called the Cylindrical Planing Machine; Uri Emmons, New York, April 25.

This machinery is confessedly similar to that for which a patent issued to William Woodworth, of Hudson, New York, in December last, Mr. Emmons claiming to be the true and original inventor; the correctness of this claim is in a fair way for investigation before the proper tribunal.

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54. For a *Machine for Washing Clothes;* Stephen Hinds, Montrose, Susquehanna county, Pennsylvania, April 25.

We wish it was universally known that all possible washing machines had been long since invented, abandoned, and reinvented, until all conceivable permutations upon every imaginable number of fluted rollers, dashers, rounds, rubbers, and squeezers, had been exhausted. We had rather visit the kitchen on a washing day, than be compelled to describe "a new and useful machine for washing clothes, churning butter, and other purposes, not heretofore known or used." Unfortunately, however, the choice is with the patentee, and the duty of submission with us.

Conceive of two gridirons, hinged together at one end, and you have the form of the washing part of this machine; but, of course, it is made of wood. This frame work is put into a wooden box, with a proper dose of soap suds, and the clothes are placed between the two racks. A lever, like a pump handle, is attached by a rod to the lower rack, which is to be worked up and down until the clothes are completely cleansed. There is no claim, and of this we are glad.

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55. For a *Hemp and Flax Machine;* Thomas Cohoon, Troy, New York, April 25.

There is so much want of clearness in the description of this machinery, which the drawings are insufficient to remove, that we cannot attempt an analysis until we see the model, which has not yet been received at the office. Should it, when it arrives, appear to merit special notice, it shall not be neglected.

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56. For an improvement in the mode of *Manufacturing Salt* from sea water, or salt springs; Henry J. Tudor, Boston, Massachusetts, April 29.

The mode of procedure for which this patent is taken, is designed to facilitate evaporation by solar heat, and seems to be well calculated to produce the intended effect. It appears to us to be new, and is presented in its simple form, without appending to it other claims of doubtful novelty, which patentees so frequently hang as dead weights about the necks of their inventions.

Double inclined planes are to be made, which will appear something like the roofs of rope walks. They may be covered with hydraulic cement, &c. or may consist simply of boards, of from 4 to

10 feet in length, running from the ridge to the eaves. The salt water is to run slowly down these, into proper gutters. In order to distribute the water upon them, there is a gutter of wood which surmounts the ridge, and this is to be filled with the salt water. Gunny bags, or any suitable kind of cloth, or other material, is used to distribute the water from the gutters upon the inclined planes; one edge of a strip of cloth lying in the water, and the other, with a ravelled edge, hanging over on to the inclined planes. The water is thus carried over by capillary attraction, and the quantity may be graduated to the weather, according as evaporation goes on more or less slowly; this is effected by allowing the water in the troughs to stand at different distances from the top. In this way brine of the same strength may be obtained whenever evaporation goes on, the quantity only being varied according to the heat and dryness of the air.

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57. For a machine for *Sifting Grain, Flour, Rice, Flax-seed, and other Seeds*, and separating all sorts of materials which are capable of separation by sifting; John Nichols, Boston, Massachusetts, April 29.

Three or more wire sieves, the frames of which form quadrangular boxes, are placed side by side, over a common box, or trough. A horizontal crank shaft, with three or more cranks on it, corresponding with the number of sieves, carry connecting rods, or pitmen, which move the sieves alternately backwards and forwards. This constitutes the whole of the machinery, which will undoubtedly operate very well. Were we desirous of using such a machine, we should even now scarcely think it necessary to buy a right; and had we *invented* it before the present patent was obtained, we should not have claimed an exclusive privilege; lest, the first wheat fan which we saw might contain a sifter with a crank, or some similar, motion.

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58. For an improvement in the construction of hose, for the purpose of supplying and distributing water to sails, or sheets of cloth, for the *Protection of Buildings from Fire*, called the "Fire Screen;" Caleb Pierce, Salem, Essex county, Massachusetts, April 29.

A common leather hose is to be perforated with holes, a few inches apart; the extreme end of this hose is to be closed, and a sail, or sheet, is to be attached to it for the purpose of retaining the water which passes through the holes. The hose may be drawn up to the eaves of a building, and the sheet allowed to hang at its side, or it may be drawn up to the ridge, and the sheet cover the roof; water is then to be supplied from a fire engine to fill the hose.

We are apprehensive that it will rarely happen that such an apparatus can be fixed and supplied with water, so as to answer the purpose intended. It is easy to try a public experiment with such a contrivance, where all is concerted beforehand; but the anxiety,

hurry, and confusion, at a serious fire, will rarely allow of that orderly and systematic procedure which such an apparatus requires. Where it could be applied, it would certainly be very useful; we are apprehensive, however, that but few rights will be purchased, and, therefore, as a patented invention, it will probably disappoint the patentee.

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59. For a *Machine for Grinding Grain, Paints, &c.;* Henry Averill, Richland, Otsego county, New York, April 30.

This is a conical mill, but differs in several points from such as have been heretofore patented. The conical part, which is the runner, is placed horizontally, being perforated its whole length, to receive an iron axis. The apex of the cone is removed, for three or four inches in length, and its place supplied by a grooved piece of cast-iron. The bed and cap stones lie flat upon each other, being properly confined in their places by iron pins. Each of these is excavated in such a form as to receive one-half of the conical runner. The grain is supplied from a hopper through a perforation extending from the apex of the cone through the cap stone. The inner gudgeon of the axis of the runner passes between the stationary stones at the apex of the cone. Its feed is regulated by a screw at the opposite end, and it may be driven by a whorl and drum, or by gearing in any other way.

It appears to be a simple and economical mill, and we should apprehend that it is very superior to several which have been introduced for domestic purposes.

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60. For an improvement in *Power Looms*, which can also be applied to other looms; Amasa Stone, Providence, Rhode Island, April 30.

This improvement consists principally in the manner in which the reed is fixed in the lathe, within which it has a certain play, which is regulated by springs; and also in the means of forming a connexion with, and communicating motion from, the back part of the reed-frame, by the intervention of a strap, lever, and wheels, to the yarn beam. A general idea of the result will be obtained from the concluding part of the specification, which is as follows:—

"In operating a loom with this improvement attached to it, when the lathe is thrown forward, the reed is pressed against the weft of the cloth, and the lathe proceeds on three-eighths of an inch, more or less. This retarded motion of the reed draws upward the strap and wires attached to them and the lever, so that the catches on the upper end of the lever gain a tooth on the ratchet wheel. By this means the ratchet wheel, the large bevelled cog wheel, the small bevelled cog wheel, the shaft, the endless screw, and the yarn beam, are all caused to move."

"The advantages of this improvement, are, that a greater quantity of work can be done with the same labour than without it—that the warp is equably delivered from the yarn beam at all times, with-

out reference to its size—that the weft is equably distributed through the whole length of the warp, and cloth can be woven, close or open, at the option of the manufacturer, and, finally, that the yarn beam will cease to move and deliver the warp, whenever the weft is broken, or out. The weight and thickness of the cloth depend wholly on the stiffness of the springs, or flighters."

"I claim as my invention the connexion of the reed with the yarn beam, and the communication of motion from the one to the other, which *may* be done as is above specified." AMASA STONE.

LIST OF AMERICAN PATENTS GRANTED IN MAY, 1829.

With Remarks and Exemplifications by the Editor.

1. For a machine called "A Wheel and Rest," to be used as a *Hemp and Flax Dresser;* as a *Grain Thrasher;* as a *Grinder of Grain, Plaster, Paints, Barks, Dye-woods,* and other hard substances; as a *Cider and Clover Mill,* and a *Hulling Machine for Barley, Oats, Rice,* &c. &c.; Israel Johnson, junr., Moriah, Essex county, New York, May 1.

The above formidable title precedes a specification of ten pages, not easily epitomized, and not sufficiently interesting to the major part of our readers, to be given at length. The simple intention of the cognomen '*wheel and rest,*' is, that a wheel is to be made to turn in the vicinity of some other body which remains at rest; and it is in the space between these that the article to be beaten, dressed, ground, thrashed, cleaned, hulled, &c. &c. &c., is to be placed.

Some familiar exemplifications of this *new principle* are given; we are told that "this principle is exemplified whenever a revolving body presents an external surface, nearly in contact with the surface of a body at rest;" "a grindstone, as commonly hung in a frame, and an artificial globe with a wooden horizon, offer familiar illustrations. The globe, with the poles in the horizon, moving from west to east, represents the WHEEL, and the east half of the horizon represents the REST, extending from pole to pole. Any or every point of this rest, may be selected as the *working point* of the machine. In like manner, if the grindstone be the wheel, half the frame becomes the rest, or rather *three* rests, one parallel to the axis, the two others at right angles to it, and parallel to each other."

This wheel and rest may form a flax dresser, or a thrashing machine, by having slats on its periphery to break and dress the flax, or to beat out the grain. It may grind by having its face covered with bur, or other stones, properly dressed. The face of the wheel may be covered with tin, or sheet-iron, or with nails, for hulling, grinding apples, &c. &c. The axis of the wheel may be horizontal, oblique, or perpendicular. Wheels performing either of these operations may be placed alone on a shaft, or the shaft may be made long enough to receive the whole of them together.

The patentee says, "what I claim as new, and as my own inven-

tion in the above described machine, with its various modifications, is, the direct application of the wheel and rest, without the intervention of costly and complicated machinery, for breaking and dressing flax, for thrashing grain, for grinding grain, plaster, paints, bark, dye-woods, and other hard substances; for grinding apples, cleaning clover seed, and hulling barley, and the like." He afterwards goes on to tell the *novelty* of all these things, in the mode in which he performs them.

After this exposition, will it not be adviseable for our millers, and other grinders, flax dressers, and performers of the multitudinous operations which have been effected by means of the "wheel and rest," from a period antecedent to the Noachian deluge, to pause and examine, lest they should interfere with newly acquired rights and claims?

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2. For *Machinery for Cutting Veneers in one Continuous Sheet*, called "Burnap's Veneer Cutter;" Caleb B. Burnap, Belfast, Waldo county, Maine, May 1.

The log to be sawed is fixed so that it may be made to revolve on centres like a piece of wood to be turned in the lathe; and, in this situation, is actually turned so as to become truly cylindrical. Circular saws, running upon the ends of mandrels, are placed in a row, with their faces in one plane, and their peripheries nearly touching, so as to cut the cylindrical log longitudinally and tangentially. A traversing motion is given either to the log, or to the frame upon which the saws are placed, sufficient to unite the cuts of the respective saws in one horizontal line.

The machinery to cause the log to revolve with any speed desired, and also to cause it to advance upon the saws, so as to preserve a regular thickness in the veneer, and to vary this thickness as may be desired, is, of course, provided, but need not now be described.

In sawing mahogany veneers, it is found that the mottle, or curl, is not generally developed by a continuous veneer all round the log. There is, therefore, described, one modification of the machinery, which is intended to cut the veneers off in segments of a large curve.

The veneer as it is cut is turned up out of the way of the saws and of their mandrels, by rollers constructed for that purpose.

The claim is to the particular methods by which the foregoing objects are effected. This kind of saw mill we believe to be new, and it is now in successful operation.

The only example with which we are acquainted of producing a similar effect, was the cutting of a large sheet of ivory, probably 16 inches square. This was done by Mr. Joshua Shaw, of Philadelphia, five or six years since. The tusk was sawed round, in Mr. Burnap's manner, but by what kind of saw, and how arranged, we are not informed.

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3. For an improvement in the *Manufacture of Spades and*

Shovels, with newly constructed handles for the same; Harlow Risley, Glastonbury, Hartford county, Connecticut, May 1.

These shovels are to be made of cast-iron, in the same form as those now in use. The top part of the blade is to have a socket cast on it to receive the wooden handle, or shaft. The upper, or bow part, for the hand, is also to be of cast-iron, with a socket for the shaft of wood to pass into.

The claim is, "the making of the blades of cast-iron with a socket on the top; and also the making of the top of the handle of cast-iron, with a socket to be put on or taken off a wooden shaft."

If a patent for making hammers of cast-iron is good, the present may also stand the test. We cannot immediately refer to the case, but are told that where a patent was taken for making mould boards of cast-iron, the patent was held to be bad, as it was merely changing the composition of matter, which the law declares shall not be deemed a discovery.

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4. For a machine for *Cutting Cheese Curd;* Anson Morris, Henderson, Jefferson county, New York, May 2.

A frame of wood is made so as to form the sides and ends of a shallow box, about ten inches square. This is divided into small squares of about $\frac{7}{16}$ of an inch each, by putting in partitions of tin, placed edgewise, these edges forming the cutters. Upon this lattice work, the curd, divided into thin sheets, is to be placed; a lid, hinged to one edge of the box, is then brought down, which presses the curd upon the cutters, and divides it into small pieces.

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5. For a mode of *Operating by Wind Power upon Machinery* for grinding and bolting grain, or for other purposes; David M'Coller, Hudson, Portage county, Ohio, May 2.

A square building is erected, each side of which is formed of folding doors. In the centre of the roof, or upper part of this building, there is a sort of cupola, or hollow cylinder, in which the wind wheel is contained, which operates like a common oblique leaved ventilator, or a smoke jack; its wings, or leaves, being placed at such an angle as shall be operated upon with the greatest power. From the centre of this wind wheel the shaft descends, which is to give motion to the grinding machinery.

When the mill is to be set in motion, the doors opposite to the quarter from which the wind blows, are to be opened, those to leeward being kept closed by weights and pullies, to give a free passage to the wind when too strong.

The claim is to a wind mill so constructed.

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6. For a *Cylindrical Rail-way Carriage;* Peter Fleming, Civil Engineer, New York, May 4.

Were we writing for southrons only, who are acquainted with tobacco rolling, we should compare this carriage, in its structure and

operation, to a hogshead of tobacco, prepared for rolling; requesting at the same time, to be freed from the suspicion of intending to disparage an invention in which much ingenuity and skill are displayed, by using a homely comparison. The carriage is a cylindrical body, which may have an axis passing through it, or gudgeons affixed to, and projecting from, its ends, for the purpose of drawing it. The wheels are iron rims placed around the cylinder so as to encompass it like hoops; these stand at a proper distance from each other, to run upon the rail; they are provided with flanches, or have their faces finished in any form suitable to the rail upon which they are to run. In the inside of the cylinder may be stowed boxes, barrels, bales, or other goods to be transported. When bars of iron, lumber, or other articles of considerable length have to be carried, the traction is performed in a different way; the carriage is then a hollow cylinder, not furnished with ends; the iron bars, boards, or plank, are passed entirely through it, and, of course, do not admit the employment of an axle, or gudgeons. In this case an endless rope is passed round the middle of the cylinder, which is furnished with double rows of pegs to form a groove, or checks, to retain the rope, or band, in its proper place. This rope also passes over a pulley, which is attached to the horse, or other drawing power, so as to work like the large and small wheels of a lathe with their bands. Two, three, or more cylindrical carriages may be made to follow each other, when connected by bands in the same way.

Under this arrangement it is evident that whatever is carried, must roll with the carriage, but in transporting some kinds of goods, and particularly in carrying *persons*, this would, to say the least of it, be very *inconvenient*. To obviate this objection, a second cylindrical body is placed inside of the first, and is made sufficiently small to revolve within it. This is suspended upon the axis, or gudgeons, and is weighted on one side, so that whilst the outer cylinder rolls upon the road, the inner one will not revolve with it. It is proposed sometimes to make this suspension by the agency of friction wheels, so as to leave but little more friction than that which results from the rolling of the carriage. The patentee says:—

"What I claim is the use of a cylinder, or other volume of revolution, on a rail-way, as a carriage, or vehicle for transportation."

"I also claim as my invention the use of the endless rope in the manner above described, for progressive motion. By means of this use of the cylinder and traction rope, friction is saved, or avoided, to a greater degree than by any machine now known. The traction rope may be employed separately from the cylindrical rail-way carriage, in any other machine where similar progressive motion is required."

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7. For an improvement in the mode of *Manufacturing Paper by Machinery*, by means of an additional machine, called the AGITATOR; Reuben Fairchild, Trumbull, Fairfield county, Connecticut, May 4.

This invention is intended to obviate a defect in the paper made upon the cylinder machines, it being very easily torn in one direction, although strong in the other; this results from the fibres of the pulp being mostly arranged longitudinally with the length of the sheet, whilst in the hand-made paper they interlock equally in all directions. The *agitator* is a semi-cylindrical cradle of metal, which lies under the cylinder in the vat, the bars of metal of which it is formed running in the direction of the circumference of the cylinder, and at a small distance from it. By means of the crank motion, the agitator is made to vibrate in the direction of the length of the cylinder, whilst the latter takes up the pulp; and in this way the fibres are to be made to interlock as effectually as in paper made in a mould. The claim is to the agitator.

A second application for a patent was made whilst the above was pending, by Messrs. Culver and Cole, of Massachusetts; their machinery was identical in principle with that of Mr. Fairchild. An amicable arrangement was effected between the parties, by which a mutual ownership of the right was established, without the vexation, loss, and delay, consequent upon a suit at law.

A patent was granted to Isaac Saunderson, of Massachusetts, on the 18th of April, for another method of attaining the same end, as may be seen in the account of it in the present number.

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8. For an improvement in the *Machine for Carding Wool;* James W. Shankland, Summerfield, Monroe county, Ohio, May 5.

Accident has prevented an examination of this patent. We will notice it hereafter.

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9. For an improvement in the application of *Felt for Carpeting;* Aaron Byington, Herkimer, Herkimer county, New York, May 6.

The specification is in the following words:—

"This improvement consists in making felt by a carding machine (with a filleting doffer) of width and length required for pieces of carpeting of various patterns, large or small, with the aid of a webbing cylinder, a creeper, and felted in the usual manner."

"After the felt is made, it is dried upon tenter bars, and sheared as cloth, and pressed. It is then printed, dried, and pressed, with a common clothier's press, when it is fit for floor carpeting, or coarse clothing, &c."

"What I claim as my invention, and for which I solicit a patent, is, the application of felt to floor carpeting, &c."

AARON BYINGTON.

The foregoing patent, it will be seen, is for a purpose similar to that of Mr. Harrington, which issued on the third of March last, (see page 412, vol. 3.) Mr. Byington, we are informed, claims to be the original inventor: and upon that ground has taken his patent.

Of their respective merits as inventors, we know nothing, but regret that Mr. Byington has framed his description in such a way as appears but little likely to establish his claim, even should it be founded in justice, particularly as there are no drawings, although such are absolutely required by the law.

The editor was superintendent of the patent office at the time the patent was issued, but neither saw the applicant or the papers until several days after the business was completed, or it would, probably, under his advice, have assumed a different form. It was one of those patents very improperly issued by a person who was at that time a clerk in the office, and whose conduct in this particular was mentioned in a note at page 409 of the last volume.

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10. For a *Revolving Four Barrelled Gun*, and improved percussion lock; Henry Rogers, Middletown, Butler county, Ohio, May 7.

The four barrels are formed by boring four holes in a block of brass of about three inches in length, and 2¼ inches square, which block is made to revolve upon a centre, so that each of its perforations may alternately be brought to coincide with the bore of the main barrel. These perforations form the chambers to contain the charges. A percussion lock is adapted to this gun. The specification does not distinctly state the particular improvements claimed. The revolving barrel itself is not new, but in the way hitherto made has not answered the expectations of the inventor, as it soon gets out of order.

A patent for a revolving barrel to contain six charges, was granted to Artemus Wheeler, of Roxbury, Massachusetts, in 1819, and we are informed that 100 rifles upon his plan were made at the United States arsenal, at Harper's ferry; and the same number upon another plan, varying somewhat from Wheeler's; very favourable anticipations were formed of their utility, but from corrosion of the metal where the barrels unite, or from other causes, a part of the charge soon escaped at this juncture, and they were all laid aside.

The present patentee states that eight shots can be made in a minute, and that one gun which he has tried, exceeds his most sanguine anticipations; it is not, however, during the honey moon that the question is to be decided whether all will "wear well."

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11. For an improvement in *Guns and Fire-arms*, which improvement consists in a priming head and cap, applied to guns and fire-arms, for the purpose of priming and giving them fire, by the means or use of percussion, fulminating, or detonating powders; Joshua Shaw, Philadelphia. First issued June 19th, 1822, surrendered for the purpose of correcting the specification, and re-issued May 7.

We expect a further communication from this gentleman on his mode of using percussion powders, &c. which will probably convey

all the information desired respecting this improvement; we shall, therefore, at present, omit entering upon the subject.

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12. For improvements in the art of *Sawing Boards and other kinds of Lumber*, and in the construction of saw mills, crank wheels, and gearing; Israel Johnson, jun., Moriah, Essex county, New York, May 7.

1st. The saw frame is to be made lighter than usual, say of 3 by 4 scantling; it is to be framed together by four cross pieces instead of two, the pair at top, and at bottom, to be each about two feet apart, with braces of wood or iron to stiffen them.

2nd. The pitman is also to be made light, with a brace from each side extending up to the bottom rail of the saw frame; this rail consequently working on three joints, or noddle pins.

3d. The crank wheel is to be balanced, that is, a weight is to be put upon the shaft upon the side opposite to the crank. A very great advantage is anticipated from so doing; as the patentee supposes that much power is lost by having to lift the weight of the crank on one side.

4th. Spring poles are to be made to operate upon the pitman. These are greatly to relieve the crank, not only in its labour of passing the dead points, but to co-operate with the power, both in raising and depressing the saw gate, or frame.

5th. A *veneer saw wedge* is to be fixed upon a thin saw plate. This wedge is a strip of iron the length of the saw, and is to be fixed upon that side of it next to the veneer. It is made wedge-shaped, its edge being placed towards the teeth, and its thick part towards the back of the saw. This is to give stiffness to a thin saw, and cause it to run as truly as a thick one. The wedge turns off the veneer, or other thin stuff which is being sawed.

6th. A horizontal circular saw running upon a vertical axis is proposed to be used. The description of this is not very clear; but it seems to be intended to cut veneers, &c. from the upper surface of a log placed upon a carriage, or from two logs at once, it being placed between them. A circular *veneer saw wedge* may be used to give it stiffness.

7th. Instead of cog wheels, friction wheels, or rather faced wheels, without teeth, turning each other by their friction, are proposed to be used for saw mills, and other heavy gearing.

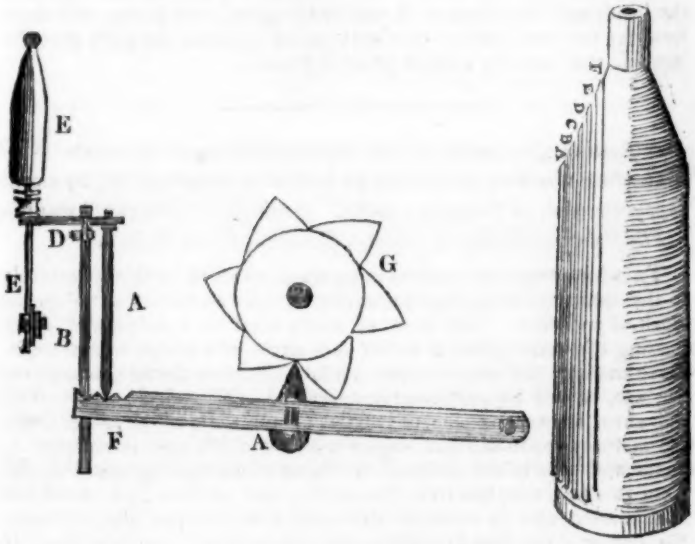
The claim is to all these, and we fear, therefore, that it is too broad. Cranks have been balanced a *thousand and one times;* faced wheels to work by their friction are acknowledged not to be new, but are claimed as applied to heavy machinery. *Query*, at what increase of size does an old contrivance become a new invention? The *veneer saw wedge* for a straight saw, appears to us to be the best of these arrangements, but if not found in good company, its influence will not be sufficiently redeeming even to save itself from legal condemnation, whatever may be the goodness of its physical properties.

Specification of a patent for an improvement in the manner of forming the Spire, or Roll of Yarn, on a Weaver's, or Shuttle Bobbin. Granted to JOHN THORP, *of Providence, Rhode Island, March* 18*th*, 1829.

THE usual method, now practised, of forming the roll of yarn on a shuttle bobbin, is, to begin at the head of the bobbin, and fill it to its full diameter, and then proceed onward towards the point of the bobbin, keeping the point of the yarn all the way in a conical shape; this is done by short vibrations of the bobbin-rail, or lifter, (so called,) together with one other slow and regular motion moving the bobbin downward, as it fills with yarn. And when the bobbins are filled to the point, or, in other words, when the bobbin-rail has fallen to its lowest position, the machinery then requires to be placed back again as it originally was, at the commencement of filling the bobbin; consequently all the bobbins require shifting at one time, whether they are full or not; and, in altering the size of the yarn, require an alteration in said regular motion. But, in the improvement, no alteration is necessary, either in the commencement of filling the bobbin, or in the different sizes of the yarn, as the vibrating, or traverse, motion, which spreads the yarn over the bobbins, always traverses the whole length of them, varying only at the point of the bobbin, at which place the traverse motions reach, or extend, one beyond another, for six or more vibrations in succession, and then returning, alternately forming a conical point to the spire of the yarn. This motion and manner of filling a bobbin, is nearly the same as that used in the common throsel or spinning frame, (excepting that the bobbins are filled moderately tapering, and with the above described variations.) There are various ways to produce the above described variations in the traverse motion—the following is one selected from a number, as being the most handy and convenient, and requiring but little alteration from the common throsel, or spinning frame—that is, to substitute a cam-wheel (in the place of the common heart) of sufficient size to contain on its surface, six or more cams, projecting from the wheel, and acting on the same lever, or levers, which said heart acted on. These cams are similar in shape to the point of a common heart, and are of different lengths, each one projecting further from the wheel, or its centre, than the former, carrying the vibrating, or bobbin-rail, further, or lower down, at one time than at another, forming a conical point to the spire, or roll of yarn, as above described. It is necessary that the point of the yarn should be formed by the points of the cams, so that a quicker motion may be gained, which is necessary in forming such point.

The above described manner of forming the spire, or roll of yarn, on a weaver's, or shuttle bobbin, and the application of the above improvement to the filling frame and throsel, I claim as my invention, desiring an exclusive property therein, and in the application of said invention and improvements to all and any spinning frame, or frames, that are, or may be, constructed for the purpose of spinning on a weaver's, or shuttle bobbin, &c. JOHN THORP.

Fig. 1. Fig. 2.



Description of the Figures.

Fig. 1. Represents a sketch of the lever and appendages of a common heart motion (so called) used in the common spinning frames, for the purpose of elevating, and giving to the bobbin the proper traverse, or vibrating, motions; also of a cam wheel, which is substituted for the common heart, for the express purpose of varying the length of the traverse, or vibrating motions at the point of the bobbin, so that a conical form should be given to the point, or spire, of yarn at that place.

The cams, or projections, of said wheel vary in length; one projecting further than another, from the surface, or centre, of said wheel, producing the above-mentioned variations, forming a conical point to the roll of yarn.

Said wheel is confined to the same shaft to which said heart belonged.

AA, Is the lever and its appendages, which is acted upon by a weight, or spring, bearing it up to said wheel, or cams.

B, The end of the spindle rail.

D, End of bobbin, or vibrating rail, on which the bobbin and whorl sets.

EE, The spindle and can.

F, The sliding bar, to which the bobbin is confined, serving to steady it.

G, The cam wheel.

Fig. 2. Represents a bobbin filled with yarn, and by tracing the vertical line from the head of the bobbin to A, thence back again to the head, and from that to B, and back again, and so on, will show how the traverse motion conducts and distributes the yarn over the bobbin, and how the conical point is formed.

Specification of a patent for an improvement in the Common Wool Carding Machine, in making an endless or perpetual roll, by means of a circular, or transverse doffer. Granted to CHARLES ATWOOD, *Middletown, Middlesex County, Connecticut, April 18th.*

THIS improvement consists in passing a sheet of cards transversely to the main cylinder, approximating so near a contact as to do the work of a doffer. This sheet of cards must be a continued sheet, passing the main cylinder either as a circle or a plane, with a transverse motion; and as a circular manner has been found best adapted for use, it will be particularly described. The circle upon which this sheet of cards is placed, is fixed upon a shaft which passes under the main cylinder at right angles with its shaft, and is secured by boxes and caps to the girths of the frame of the carding machine, and from two to six inches from the centre, and is from four to six feet in diameter, and is covered with cards from the periphery towards the centre from four to eight inches, according to the length of the main cylinder, with the points of the teeth outward, and so placed as to present a line of teeth entirely across the main cylinder, and revolving with a slow motion, it takes off the wool as it passes, and carries it round to the comb, which is affixed to a shaft by three arms, and is put in motion by a crank and pitman connected with a stud on the shaft, which causes it to vibrate on its points in two stands, which are bolted to the carding machine in such a manner that the comb will be in a tangent line with the inside circle of the sheet of cards; the vibrating motion of this comb (describing an arch of a circle,) takes off the bat of wool, and delivers it to the condensing machine, which condenses and conducts it to the can for subsequent operation.

These several parts mentioned above are put in motion by belts, or gearing, and from such parts of the carding machine as is most convenient.

The common cylindrical doffer, the common comb, the roller and the shell, are all rendered useless by this improvement. The transverse motion of the sheet of cards on a circle or a plane, across the main cylinder, with the manner of operating the comb, are what is claimed as new, and constitute the invention or improvement for which a patent is now prayed.

CHARLES ATWOOD.

Specification of a patent for a Machine for Breaking and Cleaning Hemp and Flax. Granted to AMOS SALISBURY *and* JOHN C. LANGDON, *Troy, New York, April 17th,* 1829.

THIS improvement is a machine consisting of three sets of rollers, from two to three feet in length, and ten inches, or thereabouts, in diameter.

The first set made with wooden slats, or staves, standing edgewise, mashing into each other, similar to the teeth of wheels, and, in principle, like the fluted rollers.

Each roller is composed of a shaft; two flanches, or heads, into which the ends of the staves, or slats, are fastened; and the slats running parallel with the shaft. The edges, or points of the staves or slats, of the first set of rollers, are one and a half inch distant from each other.

The second set are made in the same way, with the edges, or points of the staves, or slats, at one and a quarter inch distant from each other; the teeth or slats are consequently more in number, and finer.

The third set are made in the same way, with the edges, or points, one inch apart; consequently the teeth, or slats, are still finer than the last.

These rollers are put into an inclined frame by sets; one roller of each set directly above the other of the same set, at right angles to the plane of the machine; the hemp, or flax, to pass through between the upper and lower of each set of rollers.

To the shaft of each of the rollers is attached a cog wheel, which mashes into a corresponding one affixed to each of the adjacent rollers, so that by applying the moving power to either of the rollers, the whole of them are put in motion.

At the most elevated end of the machine is a platform so constructed that the hemp, or flax, laid upon it endwise to the rollers, will, by their revolution, be drawn between them; and, after passing through it, will be received upon a revolving cloth, or apron, at the other end of the machine.

The machine is so constructed as to occupy very little space.

The plan of this kind of roller we conceive is far better than the ordinary fluted roller, for breaking hemp or flax; the staves, or slats, being elastic, suffer the hemp, or flax, to pass through without mashing or tangling; and the spaces between the staves, or slats, and the openness of the roller, permit the shives to separate and fall through.

We propose to construct the staves, or slats, of wood, cast-iron, or wrought iron, according as the one or the other shall be found best to answer the purpose; their width, thickness, and form, may also be varied; the number of rollers, likewise, may be increased.

AMOS SALISBURY.
JOHN C. LANGDON.

Specification of a patent for an improvement in Spinning Cotton Yarns and Roping, which improvement is called "THORP'S RUNNING CAP SPINNER." *Granted to* JOHN THORP, *of Providence, Rhode Island, June 13th,* 1829.

THIS improvement in constructing the machinery for spinning, and in spinning cotton yarns and roping, consists of a short conical, running cap, the shape of which is similar to that of a tunnel with its nose downwards, hung and supported at the top of a live or running spindle. The use and functions of this cap, are, to keep the yarn and roping at a proper distance from the bobbin; also, to direct and distribute it thereon. The yarn is not connected with the cap, as in the common flyers, but it is allowed to revolve around the surface of said cap, yielding to the resistance of the atmosphere, causing it to fall back of the cap, and wind on the spool or bobbin, the lower edge of the cap being the guide. The cap should be placed near to the guide wire, so that as little length of the yarn or roping as possible be exposed to the atmosphere. The nose, or shank, of said cap is penetrated by the top of the spindle, which nicely fits it, and is held fast to its place by a screw, or a pin and slot, similar to the common method of fastening a bayonet to the end of a musket, or by a catch like that of a bit stock, or in any other suitable way. The following dimensions are suitable for spinning, on a weaver's, or shuttle bobbin; and when other bobbins are used, the dimensions must be varied to suit them. The whole length of the cap, from the top of its nose, or shank, to the lower edge of its conical part, or brim, should be about two and three-quarter inches, and the length, or depth, of the conical part about one inch. The diameter of its brim should be about an inch and one-quarter. The hole, or cavity, of said cap, after leaving the conical part, should be larger than the bobbin shaft, (which is hereafter described,) and continue of an equal diameter about the distance of an inch and a quarter, in which the top of said shaft will traverse, and the remainder of the nose above is nicely fitted to the top of the spindle, as above described. At the top of the conical part of its cavity are fixed a set of pins, say four, projecting inwards, so that their ends reach the spindle, for purposes hereinafter described. The thickness of the cap should be about the eighth of an inch; said cap may be made of iron, or any hard suitable metal. The spindle, and its situation in the frame, is like that of the common throsel, receiving its motion from the same source as that of the throsel spindle. The length of the spindle above the upper bearing, may be according to the desired length of the bobbin, which for a common shuttle, or weaver's bobbin, ought to be about seven inches. The bobbin (the body or shaft of which is a tube of thin sheet iron, or brass, or tin, or, may be, wood,) traverses on the spindle, and turns with it. Said shaft is smooth on the outside, and its head moveable on its body. The upper end of said body, or shaft, which will remain in the cap, has in it four slots, or mortises, extending down and running parallel with the spindle; in these mortises the aforesaid pins traverse; or, in other words, the mortises give liberty for the bobbin to traverse on the spindle. The pins assist in crowd-

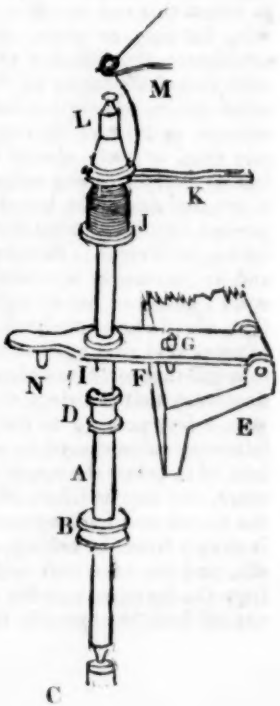
ing, or pressing, the yarn or roping down the bobbin; they also compel the bobbin to turn with the spindle. In the commencement of filling the bobbin, the head is slipped up to the top of its body, (which will be in the cap,) and by means of a spring fixed in the head, and crowding against the body, holds said head wherever it is placed. The head, together with the roll of yarn or roping, is crowded down the bobbin as fast as it fills with yarn—this is effected by the conical point of the roll of yarn, or roping, crowding within and against the conical sides of the cap at every vibration, or elevation, of the bobbin, alternately condensing the yarn or roping, and crowding it down the bobbin, until the bobbin is filled the whole length—the bottom of said body, or shaft, will set on the vibrating rail (or lifter, so called,) and will vibrate for the purpose of forming the said spire or roll of yarn, or roping. Said roll, or spire, may be slipped off from said bobbin, and placed on another of the ordinary kind, or on to a suitable tongue that may belong to the shuttle, and save the expense of fixing more than one set of bobbins in the above described manner. The bobbin, spindle, and cap, all run together, each one performing the same number of revolutions. It is necessary that there should be something to check, or obstruct, the progress of the yarn while revolving, such as the fibres of woollen cloth, or the pressure of a gentle spring touching the said cap. The use of this is to produce a friction on the yarn, causing it to fall back of the cap, and wind tighter on the bobbin; also to prevent the yarn from catching, and winding round said cap. From a number of different ways in which this can be effected, I have selected the following, viz: a thin, flat ring or plate, of iron, brass, wood, or any other suitable substance; the diameter of the hole through it, should be the same with that of the cavity of the cap at the brim, and the diameter of its outer circle, or whole substance, should be greater than that of the outside, or brim of the cap. The flat surface on the upper side of said ring, or plate, should be smooth, or may be covered with cloth, leather, velvet or any other suitable substance; said ring, or plate, is situated under the broad brim of said cap, and its upper surface is pressed lightly, against the lower flat surface of the cap, by a light spring, or weight. Between these two surfaces the yarn revolves, and by increasing or decreasing the pressure, the yarn is made to wind tighter, or not so tight, on the bobbin. Said ring has a broad, thin, elastic arm, or shank, belonging to it, which acts as the spring to press said ring against the cap, and by which the ring is confined to a rail that stretches along the frame, back of the spindles. It is necessary that the ring, or plate, be open in front, so as to give the yarn a free passage to the cap. To mend, or piece, the yarn, the following rules should be observed; the spindle is stopped by taking hold of it below the upper bearing, with one hand, while, with the other, the cap is lifted off, and held between the fingers; and with the thumb and forefinger of the same hand a sufficient length of yarn is drawn from the bobbin, and then the cap is replaced on the spindle, and the yarn cast into the guide wire, and the hand withdrawn from the spindle, and the thread pieced—or, instead of lifting the cap off from the spindle, for the purpose of piecing the yarn, it may

be done as follows, viz: the lifter on which the bobbin, or the bobbin's shaft, or body, sets, may be a spring, or may be constructed with a joint, and a handle in front, which can be taken hold of and pressed down, bringing the point of the roll of yarn, or roping, below the cap, and the upper end of said shaft, or body, below the above mentioned pins, which will allow the bobbin to turn on the spindle, so that the yarn can be drawn off and pieced. When the said lifter is pressed down, it may come in contact with the spindle, and stop it, while the yarn is put in readiness to piece—or said lifter may be held up to its place by a spring catch, and when the catch is withdrawn, the lifter will fall, giving the same opportunity to piece the yarn as above described. What I claim in this improvement as my invention, and in which I desire an exclusive property, is—the short, conical running cap, and the peculiar manner in which the yarn is conducted to the bobbin—the moveable head above described—the method of condensing the yarn, or roping, by crowding it into the cap, as above described—the method of beginning at the top, or point, of the bobbin to fill it, as above described—the crowding or slipping, the roll, or spire, of yarn or roping, down the bobbin as it fills—also the above described manner of producing a friction on the yarn that causes it to wind tighter on the bobbin—and the application of all, or any, of the above stated improvements to any kind of spinning where they may be useful.

JOHN THORP.

DESCRIPTION OF THE FIGURE.

A. The spindle.
B. The whorl.
C. the step.
D. The box that forms the upper bearing to the spindle.
E. The end of the vibrating rail.
F. The lifter.
G. A pin which has in it a notch that holds the lifter up to its place.
N. A pin that is confined to one end of a slide, or spring catch, that works under the lifter, the under end of which catches in the above mentioned notch, holding the lifter up to its place.
I. The shaft, or body of the bobbin.
J. The head of the bobbin, which is moveable on its body.
K. The ring, or plate, that presses up against the cap and yarn, causing the yarn to wind tighter on the bobbin.
L. The running cap.
M. The guide wire.
The yarn is seen upon, and extending above, the bobbin.



Specification of a patent for manufacturing of Shovels of Cast Steel and Iron, or of any other Steel and Iron, by Welding and Rolling the Steel and Iron together. Granted to ELIZABETH H. BULKLEY, *relict of* CHAUNCEY BULKLEY, *of the town of Colchester, Connecticut, February* 28, 1828.

TAKE a bar of iron of sufficient width, when rolled, for the length of a shovel or spade, scarp or slope down one side of the bar. Then take a bar of cast, or any other steel, about an inch square; draw it some, and scarp or slope down one edge; weld it on the face of the bar of iron on the side of the bar that is scarped or sloped down; heat it in a furnace, run it through a common rolling mill, until sufficiently thin for a shovel or spade. Cut up the plate crosswise, of a suitable width for a shovel or spade; shape the shovel or spade in cast-iron *dies;* make the shank of the shovel or spade of two pieces of rolled iron; rivet them on each side of the shovel or spade, with the handle in the middle. The shovel or spade to be ground and polished.

CHAUNCEY BULKLEY.

Specification of a patent for the manufacturing of Scythes by Welding and Rolling Iron and Steel together. Granted to ELIZABETH H. BULKLEY, *relict of* CHAUNCEY BULKLEY, *of Colchester, Connecticut, February* 28, 1828.

TAKE a bar of iron of a suitable size for the blade of the scythe. Hammer it till one side is a little thinner than the other; then take a thin plate of cast steel, and weld it upon the thin edge of the bar, and then roll it down to a proper degree of thinness for the blade of a scythe. Cut the plate, if necessary, into suitable lengths for a scythe, and punch holes in the back edge of the plate; then turn up the back edge of the plate, at a right angle, as high as may be requisite for the thickness of the back; then take the back, which is to be forged of iron, and punch holes through it, corresponding with the holes in the plate. Rivet the back firmly on the plate, then turn the scythe in the usual way. The back must be made so wide at the heel as to admit of the blade being rivetted upon it with two rivets.

The two preceding patents were granted in pursuance of a special act of congress, passed on the 18th of February, 1828. The petition upon which this act was founded, set forth that Chauncey Bulkley had, during his life time, been the inventor of several valuable machines, of the benefits of which he had been deprived, by his generous, but misplaced confidence in others; that he had exhausted his own resources in bringing these inventions to perfection, and had at length been removed by death, leaving his family in a destitute condition, and unable, therefore, to obtain patents for the two preceding improvements.

The petition also states, that the principle of manufacture ex-

plained in these specifications was first applied to hoes, and a patent obtained in the year 1827, by said Bulkley and others, which application has been, and still is, a source of profit to those who took advantage of the necessities of the inventor, but not to himself or his family.

In conformity with the prayer of this petition, a law was passed, ordering patents to issue without the payment of the customary fees.

Specification of a patent for a Moveable Cider Mill and Press. Granted to MOSES B. BLISS, *Pittstown, Kennebeck county, Maine, April* 21, 1829.

THIS improvement consists in combining in one moveable and entire machine, the process of reducing apples to pummage, and of extracting the liquor, by means of a newly constructed vertical wheel for grinding, its combination with other wheels, and the application of these wheels, rack and pinions, for pressing; known by the name of the "Moveable cider mill and press."

The wheel has an axis fastened in its centre, on which it revolves; its periphery is smooth, and its surfaces straight from the centre: on both surfaces are fixed a convenient number of teeth, of steel or iron, projecting horizontally, a proper length to operate on the apples. Over this wheel is a hopper (to retain and conduct the apples) decreasing at right angles with the axis as it descends towards the wheel; on both sides of the wheel, directly over the axis, is a partition, so as to admit the apples to come in contact with either quarter of each side of the wheel. The hopper, together with the wheel, may be placed on the frame of the machine, over a box into which the pummage falls for pressing.

The wheel is to be put in motion by means of a small pulley fixed to its shaft, and a band extending to a horizontal band wheel. On a perpendicular shaft of this wheel is a pinion which mashes into a cog wheel; and a pinion on the shaft of the cog wheel engages with a rack upon the piston. The rack must be disengaged from the pinion by removing a key from behind the piston, when the machine is in operation for grinding, as the piston head forms one end of the box, and must remain stationary when grinding. The power is applied to the shaft of the cog wheel, when a motion is required for grinding, and to the shaft of the band wheel when the pressing is performed; this is done by removing a sweep from one shaft to the other. After the pummage is sufficiently pressed, the bulkhead of the box is removed, and the piston extended to the front of the box, to free it of the pummage. The machine rests on two pair of wheels; one pair being smaller than the other, and adapted to turning, like the forward wheels of a wagon. It may be drawn by cattle by means of a tongue fixed to the axle of the smaller wheels. This mode of

obtaining power and motion, and the manner of moving the machine, has nothing peculiar in it.

A particular description of the frame for supporting the machinery, the dimensions of the wheels, &c., and their positions, is deemed unnecessary, because they may be varied according to circumstances.

MOSES B. BLISS.

On the Strength of Boilers.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

THE pressure of a fluid, in any given direction, on a body at rest in the fluid, is dependent on the transverse section, or base, of that body, perpendicular to the direction of the pressure, without regard to the figure of the body.

We may, therefore, suspend a cylinder for example, under water in a horizontal position, one end of which shall present a cone, and the other a plane, or flat surface, to the water, without any indications of the pressure being greater on the flat end than on the other. We may in like manner suspend a cylinder in air, (or in vacuo,) containing an elastic gas, or steam, one end of which presented to the contained steam, shall be flat, and the other concave, or we may make any other variation in the figure of the ends; but the base, or transverse section, remaining the same in all cases, the cylinder will continue at rest.

It is on this reasoning that a rule is given, and acted on by engineers, to ascertain the force exerted by a fluid (or steam) of a given density, to tear, or rend asunder, each and every part of the circumference of a cylinder in which it is contained. And according to this rule, if a ring, say of 1 inch in width, forming part of a cylindrical boiler, be subjected to investigation, the force exerted to tear asunder each and every part, is equal to the force exerted by steam of the same density on a space, equal in length to the radius of the circle, and of the same width (1 inch.)

The demonstration is as follows. Let the circle in the diagram be a ring, one inch in width, forming part of a cylindrical boiler 20 inches in diameter, and containing steam of 1 lb. to the square inch. Then the pressure on the bases *c*, *d*, and *e*, *f*, equal to the diameter *a*, *b*, will be 20 lbs. each way from the points *a* and *b*, in a horizontal direction, which pressure of 20 lbs. on the *whole* base, requires a resistance of 10 pounds at each end, *a* and *b*, to prevent the boiler from being parted at those points, or according to the rule, "as the pressure on the radius" (10 inches.)

I have been informed that the late Professor Robinson, of Edinburgh, lays down the above law and demonstration. Oliver Evans is likewise of this opinion, and gives in his "Engineer's Guide," a table of the strength of cylindrical boilers of various diameters predicated on it, and remarks, "I have never found a solution of this

so useful problem, that so often occurs in practice, in arranging steam engines, water works, pipes of conduit, &c."

I think I can show a different result from the foregoing, in so plain a manner, that all who read this article, will be able to follow me through the demonstration.

That the greater *motion* of a small force, will, in producing a mechanical effect, compensate for the greater *intensity* of another opposing force, having less motion, is well understood; but that this law, by which motion compensates for intensity, should apply when there is no motion, is not so easily comprehended.

Let it suffice for the present to state the fact, that when two opposing forces balance each other when at rest, the one force is less than the other, as the one *would* describe a greater space than the other, if motion were given to each in the direction in which they act (the relative directions and positions remaining unchanged.)

For instance, a ball is held at rest on an inclined plane, by a given power, acting in the direction of the plane, the resistance or weight is in a vertical direction.

If the ball, in being moved 1 inch up the plane, (the direction of the power) would attain but half an inch in the direction of the resistance, or vertically, the intensity of the resistance to that of the power is both in rest and motion, as 2 to 1.

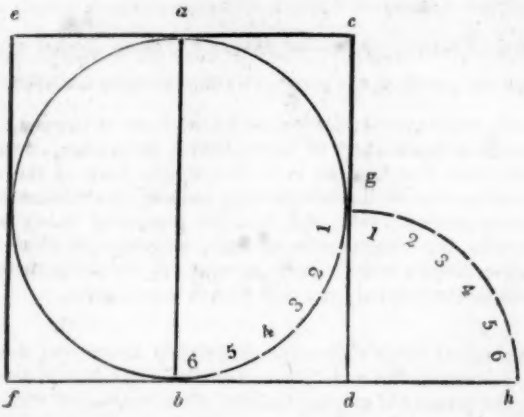
We say of the lever, that "the power is to the resistance, as the distance of each from the fulcrum." Of the inclined plane, that "the power to the resistance is as the length of the plane to its height." Of the wedge, "as the length of the wedge to its thickness." Of the crank, "as cosine to radius," &c.

All of which rules are correct and useful; but the law of motion from which they emanate, and on which they depend, is rarely examined. There are, in consequence, many persons of respectable scholastic acquirements on this subject, who are at a loss when a new case occurs, for which they have no specific rule in their "manual."

Let the circle in the diagram represent (as previously) a ring of 1 inch in width, forming part of a cylindrical boiler, 20 inches in diameter, and containing steam of 1 lb. to the square inch; and it is desired to know the resistance required at the points *a* and *b*, to prevent its parting in a horizontal direction at those points.

As the *whole* pressure tending to part the boiler, each way, from the line *a*, *b*, is sustained at the *two* points, *a* and *b*; it is only necessary to consider a quarter of the circle, say from *g* to *b*, to find the resistance at *one* of the points (as at *b*,) in a horizontal direction.

Imagine the arc *g*, *b*, divided into any number of equal planes indefinitely small, which by approximation we will call No. 1, 2, 3, 4, 5, 6, and that the steam, (or power) acts equally on these spaces in a direction from the centre of the circle. Then describe the arc *g*, *h*, which also divide into a corresponding number of equal spaces, as 1, 2, 3, 4, 5, 6.



Now the equal lengths of the lines in each space of the arc *g*, *h*, express the equal motion, which we may suppose *would* be generated by the several equal powers, and the *direction* of said lines shows the horizontal distance, which would be attained by the several resistances during said motion. Therefore the sum of all the motions (or space passed through) by the several powers, is as the length of the arc *g*, *h*. And the sum of all the horizontal distances, attained by the several corresponding resistances, is as the length of the line *d*, *h*. And, as the resistance must compensate by intensity, for what it is deficient in motion, or in space supposed to be passed through by the power, the intensity of the resistance to that of the power, is inversely as the distance, or line, *d*, *h*, to the distance, or arc, *g*, *h*.

Consequently, the strain to part the boiler, in a horizontal direction, at *a* or *b*, would be as the pressure of the contained steam, on a space equal to ¼th of the circle, instead of on a space equal to the radius. It is not unusual to work steam at 100 lbs. to the square inch, on boilers of 36 inches in diameter.

If we suppose a boiler of this size divided into rings of 1 inch in width, the steam would exert a power, to part each of these rings, of 2827 lbs., being nearly 60 per cent. greater than by the first mentioned method of estimating the force, by which process 1800 lbs. only would be the power exerted to rend each of the rings.

THOMAS W. BAKEWELL.

Cincinnati, 30*th July* 1829,

Remarks on Friction, and on the Power of Heavy Bodies in Motion.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir,—In some recent discussions of the laws of friction, and also of the power or momentum of heavy bodies in motion, it was urged on the one side, that friction is in the simple ratio of the time the rubbing surfaces of bodies are passing each other, without regard to the distance passed over; and that the powers of heavy bodies in motion are in the simple ratio of their velocity: to which the following observations were offered in reply; if you think them worthy of a place in the journal, you will please insert them. R.

There exists some difference of opinion respecting the laws of friction, as regards the velocity under which it takes place; also respecting the powers of moving bodies, when compared with their velocities.

One of these opinions as regards friction, maintains that it is equal in equal times; the other is, that it is equal in equal spaces.

One opinion maintains that the powers of moving bodies are simply as their velocities; the other, that they are as the squares of their velocities.

As a right understanding of these laws must be exceedingly important in much of the business of life, I have taken great pains to trace the effects which would result from these operations of matter, obeying these very different laws severally, which have led me to the conclusion that the latter is the true law; this will be illustrated, and, in my opinion, maintained by the reasonings which follow. In order to apply these reasonings, it is necessary to establish the principle, that the quantity of resistance opposed to any known power employed to raise a weight to any given height, will be found by multiplying the weight by the height, without regard to velocity; and, that the quantity of force,* as a moving power, that a descending body will produce, will be known by multiplying the space through which it descends by the weight of the body.

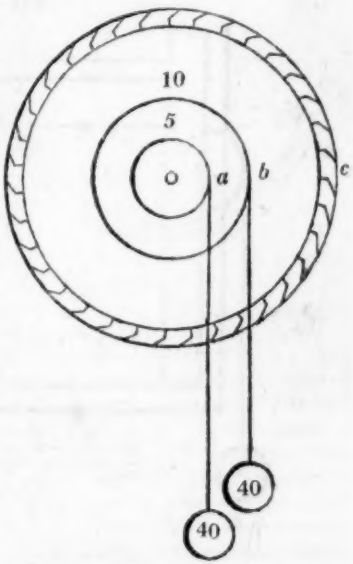
The reasoning employed, and by which it is expected the above propositions will be established, will apply simply to the abstract principle under consideration; (that is,) when I speak of the power of matter acting by gravity, either as a mover or resister, all the attendant collateral principles, such as inertia, friction, &c. will be excluded.

The quantity of resistance, from gravity, of a body to be raised to any height, will be found by multiplying the weight of the body by the height, or space through which it was raised, which is shown by the annexed figure A. representing a water wheel, 20 feet diameter, lifting a weight of 40 lbs. with different velocities; *a* and *b* are two pulleys on the water wheel shaft, *a* is 5 and *b* 10 feet diameter. Sup-

* The quantity of force is used as synonymous with power.

pose 90 lbs. of water to turn the wheel 3 times in 1 minute, and so much to be constantly on the wheel as to require 10 lbs. at *c* to balance it, which is equal to 40 lbs. at *a*. All being adjusted, the wheel is put in motion at the rate of 3 revolutions per minute, the pulley *a* winds up the cord 15 feet each revolution, that is, 45 feet in 3 revolutions, which multiplied by the weight, 40 lb. gives the quantity of resistance 1800. Now 90 lb. of water having descended 20 feet, gives the power expended $90 \times 20 = 1800$.

Fig. A.



Again, if double the quantity of water be let on the wheel, the weight 40 must be suspended at *b*, where it will balance this double quantity; all being put in motion as before at the rate of 3 revolutions per minute, 180 lb. of water will be expended in 3 revolutions; we then have by the formula, $180 \times 20 = 3600$, for the power expended, the weight 40 lb. was raised on the 10 feet pulley 90 feet, which multiplied by 40, gives 3600 for the resistance.

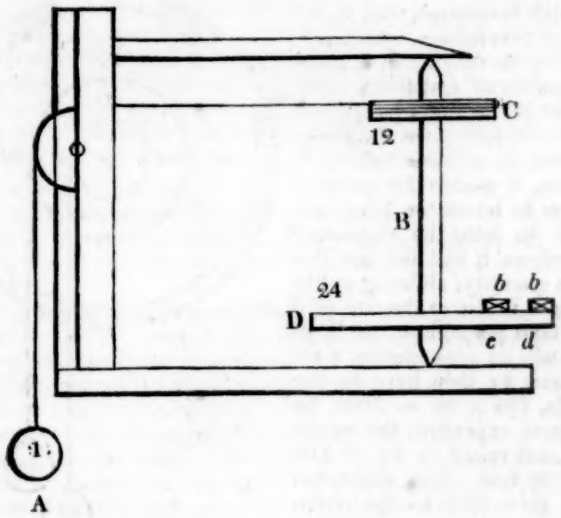
It is consistent with both theories, that the power expended, was, 1st, 1800; and, 2nd, 3600; the velocity of the wheel, and consequently the water, being the same. Then it follows, if the quantity of moving forces were, 1st, 1800, and, 2nd, 3600, the quantity of resisting forces which balanced them must have been 1800, and 3600 also.

That the resisting forces of friction are as the spaces which the rubbing surfaces of the bodies pass on each other, is shown by the annexed figure B, which represents a wheel D, turning horizontally on the vertical axis B, and put in motion by attaching the weight A of 1 lb. to a cord wound round the pulley C on the axis, which pulley is 12 inches diameter.

The body *b*, is placed on the horizontal wheel at *c*, 6 inches from its centre; this body also weighs 1 lb. and its position on the wheel exactly balances the weight A, consequently the measure of its friction or resisting force to the movement of the wheel is 1 lb. because it is applied at the same distance from the centre of the axis, as the cord suspending the weight A. The body *b*, is prevented from moving round with the wheel by a cord attaching it to a pin in a direction opposite to the motion of that part of the wheel. The wheel is then put in motion with a velocity equal to 10 revolutions per minute, the weight A descends 30 feet; we then have by the formula $30 \times 1 = 30$

for the quantity of force expended, the quantity of friction being the only resisting force, must also be 30.

Fig. B.



The weight *b*, is then placed on the wheel at *d*, 12 inches from the shaft, and secured from moving with the wheel as before; it is plain that the weight A, can urge the wheel at this point with no more than half the force with which it acted at the point *c*, in the first case, and consequently requires an additional lb. attached to the cord, when the friction *b* will be balanced, and the wheel again set in motion with the same velocity as before, and at the end of 1 minute both weights have descended 30 feet; then $30 \times 2 = 60$, the measure of the power expended; as in the other case, the friction being the only resisting force, 60 must also be the quantity of friction. In both cases the tension of the cord sustaining the body *b*, was the same, and had it been attached to a spring, would have bent it to the same degree. This seeming paradox may be explained by the annexed figures C, and D. Fig. C representing a water wheel transferring its power by the driving wheel *a*, to the pinion *b*, and through the shaft, fig. D, to the rollers 15 inches in diameter. The water wheel is 20 feet diameter, *a* is 10 feet, *b* 30 inches, and the shaft $7\frac{1}{2}$ inches diameter.

When the water is let on the wheel, the cogs of *a* press those of *b* with a force of 50, the torsion of the shaft, at its surface, will be 200, the surface of the bottom roller is urged forward with a force of 100, and a spring exerting a force of 100 in an opposite direction to the motion of the rollers would hold them in equilibrio.

The pinion *c*, 15 inches diameter, is now geared with the wheel *a*, and double the former quantity of water applied to the water wheel; the cogs of *a* will now press those of *c* with a force of 100, the torsion of the shaft *d*, and the force of the surface of the rollers the same as before; and a spring exerting a force of 100, will hold the rolls in equilibrio. In this case double the water, and of course double the power, is expended by the water wheel moving with the same velocity, but the shaft *d* and rollers move with double their former velocity, by which means two bars of iron may be rolled in the time required to roll one in the former case, and that without subjecting the shaft or rollers to a greater degree of force. Thus the seeming paradox in the case of friction, appears in this but a simple operation, familiar to most practical mechanics. On this plain principle, the force of one man exerted on a crank connected with an iron shaft not more than one inch in diameter, can be made to twist off another shaft of one foot in diameter; I therefore conclude, that the theory which supposes friction to be as the space passed over, without regard to time, is true, and entirely free from any mysterious effects in its operation.

Fig. C.

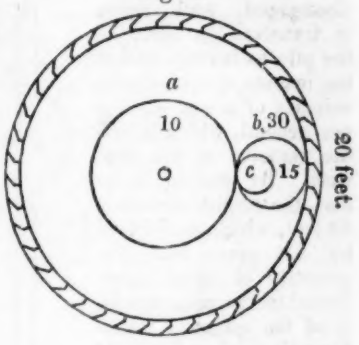
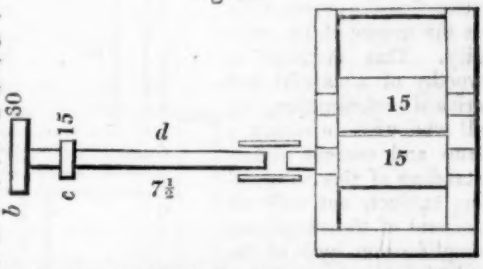
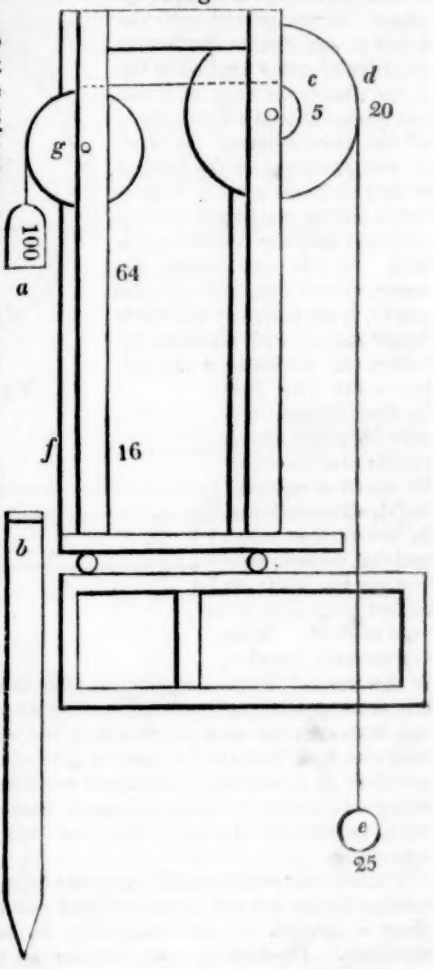


Fig. D.



I shall now endeavour to show that the forces or momentums of moving bodies are not simply as their velocities, but as the square of their velocities, by the simple Fig. E, representing a pile-driving machine. The frames being erected as shown in the figure; *a* is a body which weighs 100 lb. suspended by a cord passing over the pulley *g*, and wound round the pulley *c*, by the gravity of the body *e*, weighing 25 lbs. acting by the pulley *d*, which is attached to the axle of the pulley *c*. The pulley *d*, is 20 inches diameter, and *c*, 5 inches. The weight *e*, 25 lb. which balances, and has raised *a*, from the head of the pile 64 feet, in which operation *e* has descended 256 feet, multiplied by 25, gives 6400, which is the quantity of force transferred to *a*, and which, when disengaged from the cord, will be transferred by impact to the pile *b*, at which time the velocity of *a* will be 64 feet per second. *a* is again raised to the point *f*, 16 feet from the

Fig. D.



head of the pile, and there disengaged, and again it transfers its force to the pile as before; and at the instant of contact, the velocity of *a* was 32 feet per second, which is half the velocity of the first case. By raising *a* 16 feet, the weight *c* descends 64 feet, which, multiplied by 25, gives 600, the quantity of force transferred to the pile, that is, $\frac{1}{4}$ of the quantity transferred in the first fall of 64 feet, from which it appears that the power of *a* is as the square of its velocity. This machine is worthy of a careful and critical examination, by all who wish to obtain a true and correct understanding of this interesting subject, not only on account of the simple exemplification by it of the principles concerned, but chiefly for the important and well known effects which result from their application. If the powers are as the velocities, the mechanics who operate by these machines, have universally committed excessive errors, for they raise *a*, to as great a height as convenience will admit, thereby wasting unequal portions of the power employed to raise it; this waste increasing with the height, which waste would be avoided materially by doubling the weight *a* for every fourfold reduction of height; thus, if instead of the weight *a*, 100 lb. raised 64 feet, they had used *a*, 800 lb. raised one foot, they would have obtained the same effect, at an expense of no more than $\frac{1}{8}$ of the power; thus $800 \times 1 = 800$, the power expended to raise it 1 foot, and $100 \times 64 = 6400$, to raise 100 lb. 64 feet.

If the power of *a* equal 1600, was transferred to the pile when it was struck with a velocity 32 feet per second, and no more than double that power, viz. 3200 was transferred to the pile when it was struck

with a velocity 64 feet per second, and the power expended in *e*, transferred to *a* to produce the latter velocity, was 6400, it may be asked what became of the remaining power, that is, 3200, which must have been expended somewhere.

We should rather suspect the truth of the theory, than condemn as ignorant so great a number of men eminent for practical mechanical knowledge, obtained by extensive experience and observation, men who are undertakers and executors of heavy buildings, such as houses, stores, locks and bridges, on soft foundations, where it frequently occurs that the labour of driving the piles for the foundation is more than is expended in erecting the fabric thereon. I consider the laws which I have endeavoured to support more likely to be true than those which I oppose, because they lead to no extravagance or seeming absurdity in the details of application; and because they are supported by a variety of evidence evinced in practical operations, from which the adverse theories are excluded; to sustain some of which latter its adherents must maintain that the quantity of force necessary to move a mass of matter from this place to Pittsburg, on a level plane, will also be required to move the same matter across a table, provided each of them were the same length of time in performance; and further, that the quantity of resistance would not be increased by using runners sliding on the plane, instead of the best adjusted wheel and axle.

Philadelphia, August 10th, 1829.

NOTICES OF LITERARY AND SCIENTIFIC WORKS.

Virginia Literary Museum.—The prospectus of this Literary and Scientific journal, appeared in February last, and the first number was published on the 17th of June. Its objects are "to communicate the truths and discoveries of science to the miscellaneous reader, and to encourage a taste for polite literature."

Should it fail in attaining these ends, we may safely venture to predict that the fault will rest with the public alone, as the source from which it issues is a perennial one. The work is published at the University of Virginia, and under the auspices of its professors. Upon this simple fact its claims, in advance, may be securely rested.

It is not designed to confine this journal to "the erudite disquisitions of the scholar, or the profound researches of philosophy," but to comprehend whatever may please or instruct, admitting, therefore, the sportive effusions of wit and fancy, and thus to adapt the repast which is offered, to the diversified tastes of its readers.

In the plan and government of the University of Virginia, there is much to interest every friend of literature and science, as, in them, there is much of novelty; its founder, the venerated Jefferson, intending to establish an institution which should be adapted to the present state and wants of society. "The progress of an experiment of this high character, made by the most popular and most philosophical statesman of his age," will be recorded in this journal, and the lively curiosity respecting it, excited in the bosoms of the friends of learning, will consequently be satisfied.

The work is handsomely printed; a number issues every week, upon a sheet of super royal octavo. The terms are five dollars per annum, payable in advance; and communications, post paid, are to be addressed to the editors of the Virginia Literary Museum, University of Virginia.

The American Journal of Science and Arts.—It is now eleven years since Professor Silliman, of Yale College, commenced this journal, of which sixteen volumes have been published. At the time of its establishment, it was the only periodical of our country devoted to the natural and physical sciences, and during a large portion of the time which has elapsed since its commencement, it has stood alone; not only has it republished the discoveries made in Europe, but it has also been the vehicle of much original matter, and has thus largely contributed to diffuse both at home and abroad, a knowledge of the natural history, and the progress of general science and the arts in the United States.

The only compensation which the editor has obtained for his labours during this period, has been the approbation with which they have been received, and the conviction that he was largely contributing to the extension of useful knowledge; for whilst the merit of the work has been universally confessed, those who have supported it by their subscriptions have never exceeded six hundred, a number barely sufficient to defray the current expenses of such a work, whilst the conductor is compelled to forego many of the 'liberal things' which he devises.

Two years since an appeal was made to the public, urging the friends of science to use their efforts to extend the circulation of the Journal, by striving, individually, each to add one to the number of subscribers, and a similar appeal accompanies the number recently published. "*One thousand* subscribers are necessary to give the American Journal entire security, and to add, in the most desirable degree, to its efficiency, and to the excellence of its execution, *both in its material, and in its external dress.* Who can doubt that with proper exertions, FIVE HUNDRED ADDITIONAL SUBSCRIBERS MAY BE OBTAINED.

"The terms are three dollars a volume in advance, and there are two volumes a year, of two Nos. each; they were originally stipulated to contain 320 pages, but have averaged more than 400.

"The editor and his agents will pay to any person, one dollar for every new subscriber, who pays his advance for the year, or for one volume; and every new subscriber who volunteers his name either to the editor or his agents, with a payment in advance of five dollars, shall be credited six dollars in the first year's account.

"Returns may be made, either to the editor, or to Hezekiah Howe or A. H. Maltby, New Haven; E. Littell & brother, Philadelphia; G. & C. & H. Carvill, New York; Hilliard, Gray, Little & Wilkins, Boston, or to any of the agents of the Journal, who are authorized to fulfil the above stipulations. Complete sets of all the back volumes, can be furnished."